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Railway Mechanical Engin

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Preparedness in Engine Terminals

A good deal more could be said in favor of modernizing engine terminals than will be found in the article on Modern Versus Obsolete Engine Terminals appearing in this issue. The difficulty of operating an out-of-date engine terminal where only heavy locomotives are handled makes it a tremendous task to keep the power moving through the terminal, and the effect on the morale of shop employees that would be obtained through improving these facilities would in itself justify a considerable expenditure towards improvement.

Engine terminals might be styled the front line trenches. Without proper facilities, the day on which the power will break through these front line trenches and the locomotives descend upon the back shop will inevitably be advanced. If these terminals have modern roundhouses with adequate machine shop equipment, boiler washing plants and efficient coal and ash handling layouts, the equipment will certainly be kept in action for a much longer period, and when the break comes it will be an orderly retreat that will not tax the resources of the back shop to the limit. This simple analogy between the terminal and the trenches should be taken to heart by those who are interested in having our railroads make good.

Engine terminals should not only be modernized, but must be kept up to date. The strain on any terminal increases even more rapidly than the capacity of motive power handled, and since we must look for further increases in this direction, preparedness in engine terminals requires that these terminals be built for the future, and that there be room for additional buildings when these are needed. How often has it been necessary to change the location of an entire terminal in order to get the needed space for additional structures? It is not safe to assume that locomotives have attained their maximum capacity and that economy devices have reached the limit. It has been stated that the steel industry must double its capacity every ten years to keep abreast of this country's requirements. How long can you meet the growing requirements of your railroad with congested, poorly planned and inadequately equipped engine terminals; what is it costing your company to handle locomotives with antiquated facilities?

A. R. A. (Section III) Discusses Car Wheel Grinding

Several times recently, reference has been made in the columns of the *Railway Mechanical Engineer* to the possibilities of economy by grinding car wheels. That the subject is a pertinent and important one is indicated by the animated discussion of car wheel grinding which followed the presentation of the report of the Committee on Car Wheels at the recent convention of the American Railroad Association, Section III, at Atlantic City. C. T. Ripley, general mechanical inspector of the Atchison, Topeka & Santa Fe, called attention to the practice of reclaiming slid flat cast iron car wheels by grinding. He stated that the work has been going on for approximately ten years on the Santa Fe with important savings; no objections to the practice had developed. Cars ride smoother, there is less wear and tear on equipment and once a wheel is ground smooth, round and concentric with the journal, there is less tendency for it to slide again.

The question was raised by C. E. Fuller, superintendent of motive power of the Union Pacific, as to the depth of chill in cast iron wheels and whether there was danger of grinding through it. The consensus of opinion was that no danger of grinding through the chill existed, since it was at

least ½ in. thick; and if the chill was almost worn through, the wheel would have to be scrapped, anyway, for flange wear. Some of the members considered it dangerous practice to grind out flat spots, due to the punishment the wheel had received in sliding and the consequent danger of the wheel bursting. The answer to this argument was that badly brake burned wheels were not reground and that those with small checks were not appreciably weakened.

It developed that before the war the cost of grinding car wheels on the Santa Fe was $.53 per pair, including all overhead, interest and depreciation charges. Mr. Ripley stated that the cost is now around $1.00 per pair. In this connection, it is interesting to note that the estimated cost given in a car wheel grinding article on page 355 of the June issue of the *Railway Mechanical Engineer* is $1.50 per pair. Even this estimate of cost allows a total saving of $6.05 per pair, which is large enough to warrant the installation of a car wheel grinding machine in any shop where enough slid flat wheels are received to keep the machine busy a fair proportion of the time.

Discussion of the report also developed the fact that some roads take light truing cuts on steel wheels to remove any eccentricities in the wheels themselves or due to mounting. New chilled cast iron wheels are being ground by a large eastern road to accomplish this purpose and it seems probable that, where only a light cut is to be taken, a grinding machine will perform the operation more quickly and with less waste of material than a lathe. Certainly the ability to remove steel by grinding need not to be questioned, since powerful car wheel grinding machines are now used by manufacturers to grind the tough manganese treads of steel car wheels. The importance of the subject would seem to justify especial consideration by the Committee on Car Wheels to determine what limitations there are to car wheel grinding and to adopt recommended practices for the guidance of the roads.

Modernized Stationary Boilers

One of the most difficult problems with which the mechanical department has to contend is that of inadequate power plant capacity. The stationary boiler plant upon which the shop or roundhouse is dependent is one of the most vital spots on the railroad and unquestionably there are a very large number of outgrown, overburdened boiler installations in operation on the railroads today. The problem of increasing the efficiency and capacity of these boilers is an important and difficult one in view of the cost of installing additional boilers, which involves additional space, added foundations and setting, new boiler room construction and, finally, the boiler itself. One way in which this situation can often be improved without involving all the expense incident to the installation of new boilers is to increase the efficiency and capacity of the stationary boilers that are now in service. With all that has been said recently in favor of modernizing locomotives it is surprising that the opportunity for modernizing stationary boilers has not been given more general attention. The application of the superheater to stationary boilers would seem to offer advantages comparable with the results obtained in locomotive service. A good exposition of the improvement that can be effected through modernizing stationary boilers in railroad service will be found in an article contributed to this issue by the assistant engineer of an eastern railroad. The advantage of having ample steam pressure for the generator sets, plenty of air for the shops and good dry steam for the steam hammer is obvious; the problem is to secure the desired results with the means available. Modernizing your stationary boilers may prove a practical means.

Evolution of the Car Roof

The average roof is one of the details about a freight car that leaves much to be desired, though there are undoubtedly many specific instances of roofs that are giving eminently satisfactory service. The suggestion that the car roof is still in the process of evolution and the prediction that the ultimate roof will be rigid and of all-steel construction, comprising ⅛-in. sheets or heavier, is interesting. This suggestion and the prophecy come from a representative of the car department of the largest Canadian railroad, who is the author of a very comprehensive review of the development of the car roof recently presented before the Canadian Railway Club and abstracted in another column of this issue. The information that shingles were employed in early car roof construction is interesting in the light of subsequent developments in car roofs, as outlined in the article referred to. Not only the development, but the motive behind this development and the obstacles that have been encountered and that confront roof construction today, are plainly stated in this article. It is clearly the duty of the car department to give the car roof more attention. As is pointed out, the position of the car roof in relation to other parts of the car does not easily lend itself to proper maintenance. Other parts are constantly being inspected for defects, but roof failure is seldom observed until the damage has actually occurred. As in the famous shingling episode, the need for roof maintenance in fair weather is not apparent and in wet weather it is too late to be attended to.

The Status of Autogenous Welding

There is a growing belief that autogenous welding has its limitations. The early enthusiasm with which the process was accepted by the railroads is suffering a reaction which, no doubt, is the natural outcome of the attempt to make it a panacea for all the ills of wear or failure to which metal parts of railway equipment are heirs. There is, however, grave danger that the reaction will carry the railroads as much too far in the direction of conservatism as the early enthusiasm carried them beyond the limits of safety and economy, considering the undeveloped state of the art when it was first brought into the railroad field.

There are three prime essentials to successful autogenous welding. The first is a properly trained and experienced operator; the second is the proper preparation and laying out of the work; the third is the use of proper welding materials and appliances. The third requirement involves no real difficulty, as proper materials and appliances are available. But in the case of the first two essentials much remains to be done before the full possibilities of the art can be realized. The danger from the standpoint of future development lies not in the establishment of temporary limitations, but in failure to recognize the true nature of the cause which makes them necessary. Machinists, boilermakers, and even barbers, after a few days of special training, are alike frequently considered competent to operate on important work. When the results are not all that should be expected from really competent operators, there seems to be a tendency to attribute the failure of inherent limitations of the process itself. The fact is overlooked that success in welding depends far more on the skill and the integrity of the operator than in the case of any of the well established trades, and yet years of apprenticeship are required in these trades.

This is in no sense an argument against the establishment of such temporary limitations as are best suited to guard against danger from ill advised and incorrect applications of the process. But unless the nature of the real problem is clearly recognized the minds of many mechanical department officers will be closed to future developments and

limitations, once established, will be considered as permanent.

A few railroads have attacked with energy and thoroughness the economic and technical problems involved in the establishment of intelligent limits and correct practice in the application of autogenous welding. These roads have met with success in fields where the average experience has been failure and their success is justification for the belief that future developments will undoubtedly make possible a considerable extension of the present limitations. The art is in its infancy and its possibilities for the conservation of both labor and material are so great that it would be extremely unfortunate for the railroads if a misapprehension as to the nature of its present limitations were to delay the day when they may legitimately be extended.

Air Operated Chucks

For many kinds of work performed on lathes, especially turret lathes, boring mills and other chucking machines, there is a possibility of greatly increased production by the use of air operated chucks. This is particularly true when an order is put through in which machine operations require the chucking of a large number of duplicate parts. The time required for chucking is reduced many times over by the use of air operated chucks and at the same time the work is held so much more rigidly that it is possible to take heavier cuts and reduce materially the time required for the operations. In mechanical construction, several modern designs of air operated chucks have passed through a sufficiently long and rigorous test period to show up any weak points and objectionable features. Difficulty with the jaw operating mechanism has been largely overcome by the use of special heat treated steel levers and hardened alloy steel pivots. With hardened and ground ways in the chuck jaw slides and draw tubes, both wear and friction have been reduced to a minimum and the proper proportion of operating arms has given ample holding power. The air cylinders have presented another structural weakness, air leakage where the air enters the cylinders, especially on fast running machines, making frequent repacking and adjustment necessary. By finally providing a durable packing to overcome this difficulty and in addition making the chucks economical in air consumption, dust proof and adaptable to any ordinary type of turning machine, air operated chucks are due to come into much more common use in railway machine shops, with a corresponding increase in machine shop output.

The Critical Equipment Situation

In the January issue of the *Railway Mechanical Engineer* there was published an analysis of the railroad situation which showed a very serious shortage of facilities. During the past six months no progress has been made in reducing this shortage and the normal capacity of the railroads is at present not great enough to meet the demands of the traffic. Strikes have interfered with operation and freight has accumulated. So it happens that although the railroads are now handling more traffic than ever before, the situation is very critical. There is danger of fuel shortage in certain sections of the country; industries are not operating at full capacity and shutdowns and serious industrial depressions are threatened unless raw materials and finished products can be handled more rapidly.

A great responsibility rests on the mechanical department in this crisis. Anything short of the highest possible efficiency in transportation during the next six or eight months will be a calamity and it is the duty of every man concerned to see that the roads move as much freight as possible. There are various ways in which this can be accomplished. The first is by seeing that every employee realizes the seriousness of the situation and does his utmost by staying on the job and by doing efficient work. The eight-hour day has reduced the capacity of the shops; they cannot be enlarged to meet the present situation; therefore it is essential that there shall be no slackers.

The equipment situation is so serious that it has become a national question. Locomotives and cars must be utilized to full capacity to handle the nation's business. The percentage of locomotives needing classified repairs is not unusually high, but many engines are held out of service bcause minor repairs are not made promptly. For this reason roundhouse work should receive special attention. The bad order car figures show room for improvement; 180,000 cars, or 7.4 per cent of the freight equipment is in bad order and many cars shown as serviceable are fit only for rough freight or light loading. It may be a difficult task to improve conditions under the present circumstances, but the mechanical department should tackle the job with might and main, realizing that it can perform a great service for the country. If additions to the facilities will speed up the work, every effort should be made to install them. If changes in design will reduce maintenance troubles they should be made. Finally, if the railroad shops cannot handle the work, assistance should be secured from contract shops. The situation demands energetic action and nothing should be left undone that will speed up repairs to the equipment.

NEW BOOKS

Car Design. By L. W. Wallace, M.E. 35 pages, 6 in. by 9 in., illustrated, bound in stiff paper. Copies obtainable from H. Rubenkoenig, assistant professor of railway mechanical engineering, Purdue University, Lafayette, Ind.

This is the second edition of these notes and has been brought up to date to include recently adopted M. C. B. standards and recommended practices. The work does not exhaustively treat the subject, but deals only with such portions of the car as are usually given theoretical consideration by the car designer. It is only intended to meet the needs of classroom work, and is especially valuable to those technical schools giving railway mechanical engineering courses which include car design. The practical car designer may also derive some benefit from the work.

Woods Westinghouse E-T Air Brake Instruction Pocket Book. 258 pages, 5 in. by 6½ in., 55 illustrations, bound in cloth. Published by the Norman W. Henley Publishing Company, 2 West Forty-fifth street, New York.

Any book on air brake equipment must be strictly up to date to be of value, particularly if the book relates to the E-T type, which has undergone very rapid development to meet the ever-increasing demands upon locomotive brake equipment. This book, which has just come off the press, not only contains a full description of the E-T 6, which is the most recent type placed on locomotives, but is a very complete text on the design and operation of the entire E-T equipment and accessory apparatus. The text is admirably illustrated with cuts of the various parts of this apparatus and diagrammatic views showing each zone of air pressure in a distinctive color. This book should be of great assistance to locomotive engineers and others interested in the operation of the E-T brake equipment who are so located that they cannot take advantage of the lectures and demonstration afforded in an air brake instruction car and it should also be of value to traveling engineers, air brake inspectors and instructors not only for the information contained in the volume, but for the reason that these colored diagrams afford a very simple and effective method for instructing others in the workings of this intricate apparatus.

COMMUNICATIONS

MORE LIGHT ON THE SERVICE OF SUPPLY

West Springfield, Mass.

To the Editor:

In the June issue of the *Railway Mechanical Engineer*, under "Communications," is an article signed by General Purchasing Agent on Service of Supply. I am sure every railroad engine house or repair shop man will be interested in this General Purchasing Agent's views, for they express in a few words a full explanation of why the supply parts come to shop late and in about half requirement lots.

A man in the shop cannot devote all his time to repairing engines because the stores department fails to provide the materials required in his shop work. The shop forces must stop progressive operations and spend valuable time looking and planning to get past and deliver a locomotive when an important or perhaps only a trivial item of material is missing. It costs 72 cents per hour to have mechanics searching for parts and $2.00 per hour to hold a locomotive out of service.

My work as an engineer in charge of shop production and scheduling of the work in a locomotive repair shop has placed me in a position where definite values are known, and exactly what the factors are which tend to hold up our shop output. I know beyond a doubt that there is no one factor of distress in all our shop list that is costing more in actual cold cash through lowering of shop output and as a cause for continuing defective parts in service than the lack of an adequate supply of materials. This is our worst shop problem today.

If our General Purchasing Agent could spend one day each month alone among the shop and engine house foremen, learn to know the gang leaders and their troubles, he would not make any such slip as he did by saying "No such thing as work held for material." *Work is delayed every day because of lack of material.*

Men of vision and business determination create their credits as they advance, and see to it that subsequent events produce the requisite profit to meet their obligations. Credit is established and maintained by meeting every business obligation promptly and squarely. Where would any of our large roads have been today had they hesitated to advance because of credits? Harriman, Hill, and others advanced and their credits expanded to meet their requirements.

Suppose, for example, we require three 1¼-inch pipe unions to complete a locomotive out of shop and into service. The store room only received one because the 30 per cent credit after being distributed only purchased one. This locomotive must go into service, and there are, we assume, only two pipe unions, a matter of $1.00 between it and earning $75.00 per day. Our piper spends perhaps an hour searching scrap for old ones; perhaps finds a poor one that may just about half-way hold, or long enough to get out of shop and give the engine house trouble later. This hour's time of piper and helper places this union at a cost of 72 cents + 49 cents, or $1.21. But we are still short one, and the only thing to do is to rob from any locomotive in the shop or from some shop heating pipe. A chance of losing $75.00 per day in service earnings forces anything so long as we obtain the required fitting. Later we will have to replace it by robbing another and the labor charge will average $2.00 each for these fittings.

The vital point is we pay for all our material, even though we have to hide half the cost in labor charge. Give us new material at a less cost to the company and place the cost where it belongs, on the purchasing agent's books, and not on shop pay-roll. The increased saving in the direct purchase will sustain the credit advanced, not to mention the intangible effect in dollars resulting from encouraging the shop men.

Who ever heard of a general purchasing agent crying himself to sleep because a wrecking crane cost $25,000, and perhaps stands 12 months and never is used and passing into an obsolete class every day? Or we must scrap it and purchase a larger one to stand around on the siding, tying up a larger sum and losing more interest. The fact is, when we require this crane we want it at once, and very urgently, and in a few minutes' time it liquidates all this interest and depreciation charge. It is not too much in large wrecks to say a crane may save its entire cost on one job. The same thing applies to material stocks; we should not stock carelessly but wisely, and do it as a feature of good business management. Do not state "The road in possession of the largest stock of live stores is the poorest managed."

You do not cut down on coal because of depleted credits. You spend $2,500 on a locomotive to apply superheat and save coal. Here you advance credit and sustain it on the saving in coal. Nothing strange about it, just good hard-headed, plain business sense.

Frank Roberts.

PIECEWORK NEEDED TO INCREASE PRODUCTION

Roselle Park, N. J.

To the Editor:

I read with much interest the letter printed in the May issue of the *Railway Mechanical Engineer* entitled The Mechanic's Viewpoint. However, I wish to disagree with the author on one point in particular, namely his opposition to piecework and his reasons therefor.

I claim that the time has arrived to again install the piecework system in railroad shops in order to increase efficiency and production, which have fallen during the last two years. It is a well-known fact that a good deal of this reduction in output was due to the abolition of the piecework system. To pay men according to their occupation on a flat base is unjust to the good worker and the poor worker. The one is underpaid and the other overpaid. The workman working at an efficiency of 90 per cent should receive more pay than the one working at 80, 70 or less per cent. This should be done by a proper piecework or bonus system. There must always be an incentive for mechanics to increase production and where this incentive is lacking the best workmen will fall to the level of the average and the supervising forces will have to devote a good deal of their time to keeping the slackers on the job. Your correspondent thinks "indifferent quality" is unavoidable under the piecework system. I don't think so; in fact the contrary is nearer to the truth. With a live piecework inspector on the job and the supervising forces not sleeping it is easier to obtain good workmanship under the piecework system than when working at the day rate. Under the piecework system employees can be held to strict accountability for performing inferior or indifferent work. In some cases where carelessness or neglect is shown they can be disciplined by making them do their work over again without extra pay. This usually acts as a sure cure against carelessness.

As far as the nerves of the nation are concerned, I don't think this should worry us if we approach the subject with a fair mind and spirit. Piecework or bonus prices should be set according to the output of an average good mechanic.

The high cost of living today is due to a large extent to under-production of the American workman. Less is being produced per day per man than formerly and more is being demanded. The logical thing to do then is to produce more, and since a proper piecework or bonus system will work along such lines it should be installed again in railroad shops for the benefit of the faithful railroad mechanics and helpers, the owners of the railroads and the public.

Frank J. Borer.

Locomotive Feed Water Heating*

Development and Possibilities Outlined with Particular Reference Made to the Open Type of Heater

BY THOMAS C. McBRIDE

THE use of feedwater heaters on locomotives dates back to the beginning of the locomotive itself. There are records of the application of an "open" or "injection" type heater to a locomotive in England in 1827, and an English patent of 1828 describes a tubular heater for the same purpose. Ross Winans of Baltimore applied tubular heaters to two types of Baltimore & Ohio railroad locomotives in 1836. It is worthy of note that the desirability of the feedwater heater for the locomotive was recognized at these early dates, although it must be appreciated that the advantages possible at that time were proportionately greater than at the present time because of the low-steam pressure then in use.

Every conceivable type of heater and all possible sources of heat, even the hot ashes, seem to have been proposed or tried,

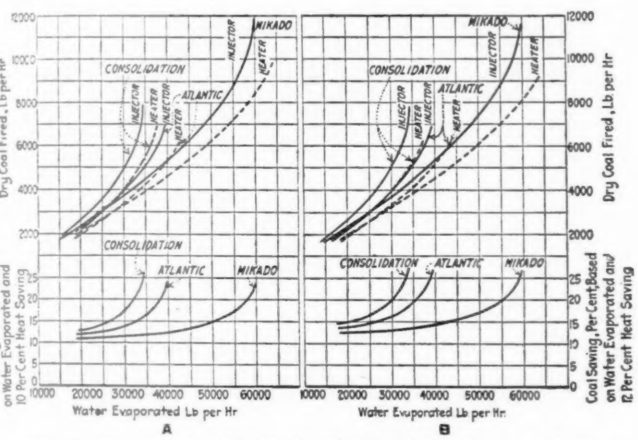


Fig. 1—Curves Showing Estimated Coal Saving with Feed Water Heater

and in view of the amount of study that has been given to the subject it seems rather remarkable that locomotive feedwater heating is not now in more general use. Possibly the reason lies in the fact that it is only in comparatively recent years that the essentials of heater performance and pump operation have been understood. Furthermore the small size of the locomotives formerly in general use limited the saving per locomotive, and the general adoption of the injector, because of its simplicity and convenience, rendered feedwater heating impossible, for injectors heat the water which they use to such an extent by live steam that there is little or no opportunity for further heating.

There are two possible sources in a locomotive from which otherwise waste heat may be obtained to heat the feedwater: (*a*) the waste gases in the smokebox or stack, (*b*) the exhaust steam. Stationary practice with economizers indicates that waste-gas heaters cannot be supplied with cold water because the accumulation of condensation and soot on them seriously interferes with their efficiency. It is, therefore, necessary to turn to the exhaust steam for the source of heat and to develop this type of heater first, leaving the waste-gas heater for later development as may be found either necessary or advisable.

The exhaust-steam heater may be either of the open or injection type in which the exhaust steam comes into direct contact with the cold feedwater so that the water condensed from this exhaust steam is added to and mixed with this feedwater; or, of the closed or surface type in which the heat from the condensation of the exhaust steam passes to the feedwater through thin sheets of metal, generally in the form of thin brass tubes. Practically all of the development work to date that has been at all successful has considered only the surface type. There are a great many heaters of this type in service in Europe, but there are objections to it for locomotive use. It is a complex and delicate structure; it also wastes the water condensed from the exhaust steam with its heat or raises complications as to saving it, and it requires enough exhaust steam to heat all of the feedwater. On the other hand, the open or injection type of heater necessarily recovers both the water condensed from the exhaust steam and its heat so that both are returned direct to the boiler with the water taken from the tender. Less water is therefore taken from the tender and less exhaust steam is required for the heating.

The McBride Feedwater Heater

The adoption of an open heater for the locomotive may seem a radical step, but the author has devised an open type of feedwater heater which is being manufactured by The Worthington Pump and Machinery Corporation and is fully described in the *Railway Age* of Sept. 5, 1919, in which no new elements are used. The heater itself is of a general type that has been in use in marine service for at least twenty years.

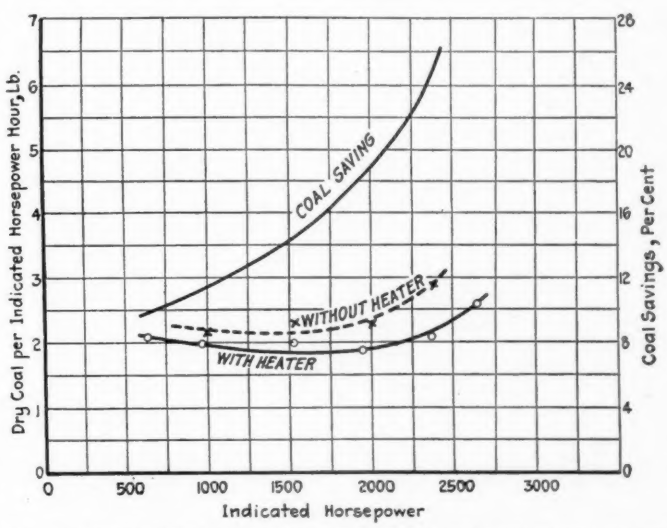


Fig. 2—Curves Showing Coal Saving Based on Test Plant Results

The open heater with the oil separator to remove the oil from the exhaust steam before it enters the heater because of its merits has been almost universally adopted for stationary plants. One of these heater and pump units was thoroughly tested out on the locomotive test plant of the Pennsylvania Railroad at Altoona, Pa., in 1917, and has been in operation on road service since October, 1918. Three more units have been in operation for approximately a year on pooled locomotives and have given no trouble other than the usual pump maintenance. Nothing has developed indicating that the open heater as a type is not well adapted to the locomotive and the coal and water savings have been so marked as to be evident to the crew.

The pump is much easier to operate than an injector, as it

*From a paper presented at the spring meeting, St. Louis, Mo., May, 1920, of the American Society of Mechanical Engineers.

requires only a slight turn of the 1-in. throttle valve to either start it or to make it run faster or slower as the boiler may need more or less water. It does not require priming and can be operated continuously at low capacities where the injector must be stopped and started periodically. The feed pump should not be used, as is often done with the injector, to fill the boiler on the down grade and then be shut off as long as possible on the up grade; first, because there is not as much inducement or necessity for operating it in this way and, secondly, because the prime purpose of the heater is to recover heat and it can only do so when the locomotive is pulling and exhaust steam is available for the heating. If the injector is operated continuously and maintains a constant water level in the boiler each pound of steam generated will require 1,276 B.t.u. from the fire with 200 lb. steam pressure, 150 deg. superheat, and 40 deg. water in the tender. If the injector is shut off each pound of steam will require somewhat more than 925 B.t.u. so that the amount of steam from the same fire will be increased less than 38 per cent. It will later be shown that under the same conditions the feedwater heater would increase the amount of steam about 13.6 per cent. The feedwater heater will, therefore, materially increase the amount of steam on the up grade, although not to the extent possible in the case of the injector, and should be depended upon to feed the boiler entirely on the up grade with the consequent greater amount of heat recovered from the exhaust and more nearly constant water level in the boiler.

Advantages of Locomotive Feedwater Heating

It is not possible to make an exact general statement of the advantages to be obtained from locomotive feedwater heating, because much depends on the particular locomotive to which the heater is to be attached, the capacity at which it is worked, the temperature of the water in the tender, and the basis on which the advantages obtained are stated. We are liable to base our notions as to the advantages of feedwater heating on the results obtained in stationary practice where the coal saving is very properly considered as equivalent to the reduction in the amount of heat necessary to evaporate the water because of the higher temperature at which the water is delivered to the boiler. In the case of the locomotive, however, with its very complicated relations of the different operations that are going on, and the very wide range of capacity through which the boiler is operated, there is generally a much greater coal saving than in stationary practice. Three factors enter into the final result: 1, the reduction in the amount of heat required to evaporate the water in the boiler, which might be called the *heat saving due to the feedwater heater.* 2. The reduction in the amount of heat required results in a greater reduction in the amount of coal required because of the better efficiency of the boiler at the lower rate of combustion. These two factors give the *coal saving based on water evaporated.* 3. The exhaust steam taken by the heater from the exhaust ports of the locomotive reduces slightly the back pressure in the locomotive and should show some advantage. All three factors combined will give the *coal saving based on indicated horsepower.*

Heat Saving Due to Feedwater Heater

The first factor, the heat saving, is determined by the amount the feedwater is heated by exhaust steam taken from the locomotive. This factor will evidently be greatest when the tender-water temperature is low and when the exhaust steam pressure in the heater is highest, as this pressure determines the temperature to which the feedwater can be heated. This pressure will be highest when the locomotive is working hard, and when the exhaust steam for the heater is taken from that part of the steam valve chests or cylinder saddles where its pressure is greatest. The exhaust steam from the feed pump need not be wasted, since it can be and is used in the feedwater heater, but this use prevents the recovery of the same amount of exhaust steam and heat from the exhaust of the locomotive. The amount of steam used by the feed pump is, therefore, a direct charge against the saving due to feedwater heating as compared to injector operation when considered in the light of recovery of waste heat from the locomotive exhaust, or when estimated by the temperature rise of the feedwater in the heater.

The tabulation given in Table 1 is based on heating the feedwater to 215 deg. This is quite conservative, as it has been found easily possible to obtain this temperature with the open type heater referred to even with tender-water temperatures of 40 deg. and on locomotives worked at less than two-thirds of their maximum steaming capacity. The tabulation shows that greater heat saving is possible with saturated than with superheated steam locomotives; therefore the percentage of coal saving will be greater with saturated than with superheated steam locomotives. Table 2 gives the exhaust steam required for the heating. The percentage of water saved is shown by Table 3.

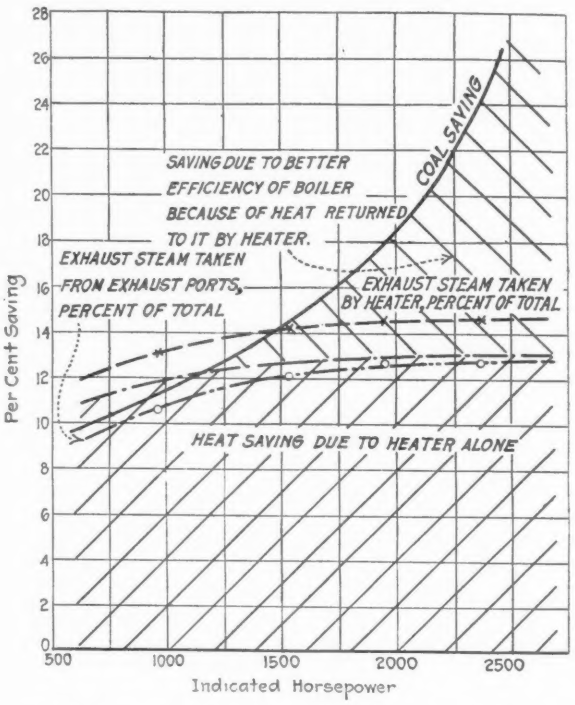


Fig. 3—Analysis of Coal Saving Resulting from Feed Water Heating

TABLE 1—HEAT SAVING DUE TO FEEDWATER HEATER

Assumed steam pressure in branch pipe, lb. per sq. in.	200	200	200	200
Assumed superheat, deg. fahr.	None	None	150	150
Assumed temperature water in tender, deg. Fahr.	40	70	40	70
Heat content per pound of steam, B.t.u.	1199.1	1199.1	1284.6	1284.6
Heat content per pound of water, B.t.u.:				
At 40 deg.	8.0	.....	8.0	.....
At 70 deg.	.....	38.0	.....	38.0
Heat required to generate one pound of steam, B.t.u.	1191.1	1161.1	1276.6	1246.6
Heat saving in B.t.u. when water is heated from:				
40 to 215 deg.	175.0	.....	175.0	.....
70 to 215 deg.	.....	145.0	.....	145.0
Heat saving, per cent.	14.7	12.5	13.7	11.6
Total heat required by locomotive with feed pump as compared to injector operation, per cent.	102	102	101.75	101.75
Heat saving in locomotive with heater as compared to injector operation, per cent	15.0	12.75	13.94	11.80
Heat required, per cent.	87.0	89.25	87.81	89.95
Heat saving as compared to injector operation, per cent.	13.0	10.75	12.2	10.05

The allowances which have been made for the steam used by the feed pump are based on carefully conducted tests of the feed pump and heater, which show that this feed pump when running with saturated and fairly wet steam required for its

operation 2 per cent or less of the weight of steam generated by the boiler. The feed pump, therefore, uses 2 per cent or less of the heat required from the fire by the saturated steam locomotive, but in the case of superheated steam locomotive the feed pump will require but about 1.75 per cent of the heat from the fire of the locomotive because of the greater heat required to generate the superheated steam. The tabulation is based on steam leaving the branch pipe at 200 lb. pressure

TABLE 2—EXHAUST STEAM REQUIRED FOR HEATING

Assume tender water temperature, deg. Fahr	40	70
B.t.u. required to heat one pound of feedwater to 215 deg.:		
From 40 deg	175	.....
From 70 deg	...	145
Heat content of exhaust steam assumed at 7 lb. pressure B.t.u. per lb	1157	1157
Heat content of water at 215 deg. B.t.u. per lb	183	183
Heat given up by exhaust steam in condensing from 7 lb. pressure to water at 215 deg. B.t.u. per lb	974	974
Exhaust steam required to heat one pound of cold feedwater, per cent	18	15
Exhaust steam to heater from feed pump, per cent	2	2
Exhaust steam from exhaust ports of locomotive required by surface heater, per cent	16	13
By open heater, per cent	13.8	11.5

with 150 deg. superheat in the superheated steam locomotive and gives value of the heat saving, water saving, and percentage of exhaust steam required by the heater for tender-water temperatures of 40 and 70 deg. respectively. The term "heat content" is used to express the amount of heat in the water or steam above that in water at 32 deg. Fahr. temperature.

From the tabulation it will also be noted that in the case of the feedwater heater for the locomotive, because of its comparison to injector operation, it is not possible to apply the usual short rule customary in stationary practice stating that a certain number of degrees of heating of the feedwater results in 1 per cent heat saving, but rather that it is more exact to state, assuming the conditions of the table, that in the saturated steam locomotive, after the first 23.8 or 23.2 deg. heating, each 11.9 or 11.6 deg. of heating represents 1 per cent heat saving, and that in the superheated steam locomotive after the first 22.3 or 21.8 deg. of heating each 12.8 or 12.5 deg. of heating represents 1 per cent heat saving, the first figures in each case applying with 40 deg. and the second figures with 70 deg. water temperature.

TABLE 3—WATER SAVING DUE TO FEEDWATER HEATER

Steam for locomotive cylinders, per cent	100	100
Steam required for feed pump, per cent	2	2
Water required by locomotive with surface heater discharging water condensed from exhaust steam to track, as compared to injector operation, per cent	102	102
Exhaust steam condensed in heating feed water, per cent:		
0.18 × 102	18.4	.....
0.15 × 102	.....	15.3
Water required by locomotive with open heater or surface heater saving condensation from exhaust steam compared to injector operation, per cent	83.6	86.7
Water saving, per cent	16.4	13.3

The locomotive with the open heater or the surface heater saving the water condensed from the exhaust steam requires the extra 2 per cent steam to operate the feed pump, but from 15 to 18 per cent of this 102 per cent is recovered, so that the net water saving is from 13.3 to 16.4 per cent respectively for the assumed summer and winter conditions as compared to injector operation.

Coal Saving Based on Water Evaporated

In order to obtain the coal saving based on water evaporated it is necessary to consider particular locomotives, since this factor involves the change in the efficiency of the boiler with varying boiler capacity. For this purpose the curves of Fig. 1 have been prepared. The curves on the left marked A are on the basis of 10 per cent heat saving; those on the right marked B on the basis of 12 per cent heat saving. The upper solid curves marked "injector" are test plant results of a consolidation, atlantic, and mikado type locomotive respectively and show the total amount of water evaporated per hour against dry coal fired. The dotted curves marked "heater" for each of these three locomotives show the amount of water that would have been evaporated by the same amount of coal with a feedwater heater reducing by 10 per cent and 12 per cent respectively the amount of heat required to evaporate the water and superheat the steam. The vertical distances between the solid and dotted curves represent the amount of coal saved and these quantities are shown in the lower set of curves. This lower set of curves, therefore, shows the coal saving based on water evaporated due to the feedwater heater that follows a reduction of 10 per cent and 12 per cent respctively in the amount of heat necessary to evaporate the water and superheat the steam. These curves show that the feedwater heater attached to a locomotive will effect a coal saving beginning at low capacities practically identical with the heat saving, or the coal saving which we have been accustomed to in stationary practice, but which increases at first gradually and then more rapidly as the capacity of the locomotive is increased, reaching values twice or more than twice these figures as the maximum capacity of the locomotive is approached. It would be difficult to credit this result were it not warranted theoretically by the second factor mentioned above, and had it not been confirmed in test plant results with a wide margin to spare. A study of the upper curves in connection with the lower curves of both figures will show that the very great coal saving possible is accompanied by an increase in steaming capacity due to the feedwater heater and that it should be possible to work the locomotive with the heater at greater steaming capacities than are possible with the injector, but how much greater would depend largely on the particular locomotive.

Coal Saving Based on Indicated Horsepower

Saturated steam locomotives should show a further gain of a few per cent from reduced back pressure. Test plant records show some reduction in this back pressure in superheated steam locomotives accompanied by a reduction in superheat and indicate that, at least until further tests are made, this factor should not be considered for superheated steam locomotives. The curves shown in Fig. 2 are based on test plant results of a mikado locomotive, comparing its operation with the injector and with the feedwater heater referred to in this paper. Table 4 shows the heat recovered by the feedwater heater and Table 5 the coal saving and increase in efficiency. They show a coal saving curve of the same general

TABLE 4—HEAT RECOVERED BY THE FEEDWATER HEATER

Test No.	1	2	3	4
Steam to engine, lb. per min	314.5	492.8	599.1	757.3
Steam to feed pump, lb. per min.	7.4	10.5	12.5	14.6
Steam to safety valve, lb. per min.	0.8	0.7	2.1	5.5
Exhaust steam condensed, lb. per min.	42.3	71.4	90.0	113.7
Heat in steam, B.t.u. per min. to engines	402,749	639,063	780,867	996,531
To feed pump	8,876	12,594	14,994	17,393
To satety valve	960	840	2,519	6,597
Total heat in steam	412,585	652,497	798,380	1,020,521
Heat recovered from exhaust, B.tu. per min	50,725	85,694	108,063	136,736
Per cent of total heat	12.3	13.1	13.5	13.4

TABLE 5—COAL SAVING AND INCREASE IN EFFICIENCY WITH FEEDWATER HEATER

Test Nos.	1 and 5	2 and 6	3 and 7	4 and 8
Speed in m. p. h	14.6	14.6	22.0	22.0
Indicated horsepower:				
Without heater	990	1549	2001	2388
With heater	965	1534	1949	2373
Coal per indicated horse-power hour, lb.:				
Without heater	2.2	2.3	2.3	2.9
With heater	2.0	2.0	1.9	2.2
Coal saving by feed heating, per cent.	9.1	13.1	17.4	24.7
Drawbar horsepower:				
Without heater	824	1289	1690	2019
With heater	783	1293	1679	2055
Thermal efficiency of locomotive, per cent:				
Without heater	7.0	6.7	6.7	5.4
With heater	7.6	8.0	8.6	7.8
Increase in efficiency with heater, per cent	8.5	19.4	28.3	44.4

character, but slightly higher than the curve for the mikado locomotive of Fig. 1, based on water evaporated, although the tests were made under practically identical operating conditions as to temperatures and pressures.

Exhaust Steam Available for the Draft

The question has been raised as to whether the exhaust steam taken from the locomotive by the feedwater heater would cause trouble with the draft. This question could be analyzed from the partly theoretical curves of Fig. 1, but as actual operating conditions are of more interest, curves have been added to Fig. 3 showing the total exhaust steam taken by the heater and the exhaust steam taken from the exhaust ports of the locomotive. The distance between these two curves represents the exhaust steam furnished by the feed pump to the heater. It is noted that the curve of exhaust steam taken from the exhaust port is below the curve of coal saving. The feedwater heater, therefore, reduced the amount of coal burned at a greater rate than it reduced the amount of exhaust steam, so that there was a surplus of exhaust steam left available for the draft, no necessity for reducing the size of the blast nozzle and consequent possibility of reduced back pressure in the locomotive cylinders because of this heater. For instance, at 2000 i.h.p., the reduction in the amount of coal burned was 18 per cent, and in the amount of exhaust steam, 12½ per cent. As compared to injector operation, 82 parts of coal had to be burned and 87½ parts of exhaust steam were left available for the draft to burn it.

Conclusions

Viewed from the standpoint of coal and water saving, the adoption of the heater becomes a question of interest on first cost, depreciation and maintenance cost against these savings. Viewed from the standpoint of increased capacity, the question becomes one as to whether the feedwater heater does not offer increased capacity at the lowest first cost, especially if, as in the case of the comparison of the consolidation locomotive with and the mikado locomotive without a heater, the adoption of the heater permits of the use of a simpler and less costly type of locomotive. The feedwater heater offers a solution of the pressing problem of these times, when so many fairly old and small locomotives have outgrown their usefulness because they are not large enough for present-day demands. The feedwater heater will not only increase the capacity of these locomotives, or what might be called their economical operating capacity, at a comparatively low cost and with little change in them, but it will also show a larger percentage of coal saving because of their full loading than would be obtained with present-day larger locomotives. The feedwater heater offers the peculiar advantage of being of most assistance to the locomotive just at the time when the locomotive needs assistance. It offers its greatest saving in fuel or increase in capacity in the winter time, and these advantages are not effected by reduced steam pressure or superheat, but continue in spite of them and at a proportionately greater rate.

THERE WAS A MAN in our shop, he was so wondrous wise; he wouldn't wear his goggles—now he has no eyes—*Fred Meyers.*

METHOD OF KEEPING COMPRESSOR VALVES CLEAN.—Air compressor valves in a certain plant, after a few days' run, would cake with dirt and rust and show signs of corrosion. The explanation offered was that carbonic acid formed by the carbon dioxide and moisture of the air attacked the valves and caused the trouble. It was suggested that a weak alkali such as a soap solution would be sufficient to neutralize the acid and prevent the trouble. One quarter pint of soapy water was fed to the low pressure lubricator three times a day, and since that time the valves have remained clean and have a mirror-like polish.—*The Atlantic Lubricator.*

SPECIAL LOCOMOTIVE DEVICES ON THE ANN ARBOR

In March, 1919, two 11-in. air compressors were applied to a locomotive on the Ann Arbor Railroad, the piston rods to these pumps being drilled and equipped with special means for the lubrication of the air cylinders as shown in Fig. 1. The special features involved in this means of lubrication were designed by J. E. Osmer, superintendent of motive power of the Ann Arbor, and application for patents covering the novel features of the device has been filed.

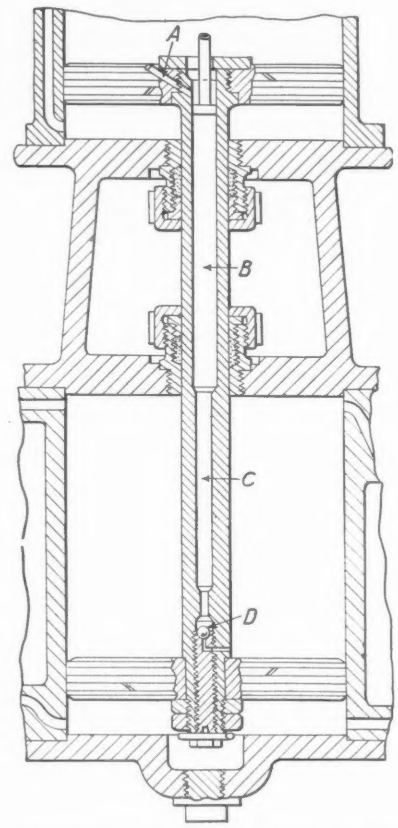


Fig. 1—Arrangement for Lubricating Air Cylinders

The air intakes consisted of pipes leading down at an angle of about 20 inches from the air cylinder, and on the lower end of the pipe Westinghouse air strainers were applied, thereby preventing any oil getting to the air cylinders from any other source than through these piston rods. On

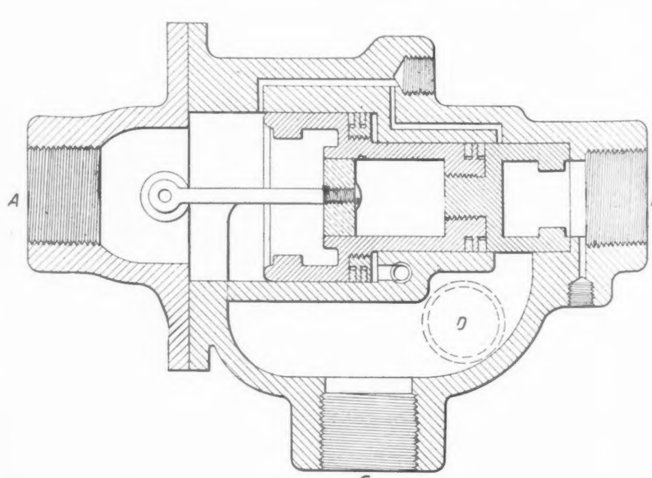


Fig. 2—Combination Valve for Distributing Superheated Steam

the downward stroke with steam pressure exerted to the top side of the piston, pressure is also exerted above the oil and water collected in passages holding ball *D* down to its seat. On the upward stroke and if the piston in the air cylinder has traveled one inch, enough pressure has been accumulated to raise ball *D* off the lower seat and force it against the upper seat, thereby permitting the oil and water collected in cavity *C* to pass into and against the cylinder walls.

It is stated that since the application of this arrangement to the air pumps, no indication of groaning has been experienced, and the air passages and the air discharge pipes are absolutely free from carbon. These pumps have run one year between the shoppings of this locomotive, and when the pumps were dismantled it was found that there were no indications of scoring. The same air valves and seats were put back into the pumps and the same pumps are now in service giving satisfactory results.

At the time this installation was made, an automatic valve was also installed as shown in Fig. 2, the duty of which was to furnish superheat steam to the steam end of the air pumps at all times when the throttle of the locomotive might be open, and since the date of its application over a year ago, an increase in speed of the pumps has been noticed with the use of superheated steam over the use of saturated steam when the main throttle is closed and a considerable fuel saving has been observed. This same arrangement also has a special field in connection with the operation of locomotive stokers, coal pushers, and other devices.

Superheat steam from the superheater header on the steam pipe is connected at *A*. The usual steam pipe from the boiler head ordinarily connected to the air pump, steam heat stroker, etc., may be connected at *B*. *C* is the steam delivery pipe to air pumps, steam heat pipes, etc. *D* may be used as a connection to furnish steam to the electric generator. When the differential piston moves to the left, the rounded end of the piston rod seats against a copper gasket, making the joint absolutely steam tight. At the end of the smaller portion of the differential piston, this being cast iron against cast iron, no wire drawing of steam is noticeable due to the fact that in the passage *B* and in the conducting passage to *C*, pressure being practically balanced, eliminates any wire drawing.

Railway Fuel Association Proceedings

Reports and Papers on Feed Water Heaters and Possibilities of Lignite and Carbonized Coals

The twelfth annual meeting of the International Railway Fuel Association was held at the Hotel Sherman, Chicago, May 24 to 26 inclusive, with H. B. McFarland, engineer of tests, Atchison, Topeka & Santa Fe, presiding. The convention was opened with an invocation by Dr. Frank Gunsaulus, president of Armour Institute of Technology, followed by an address by Roy V. Wright, editor of the *Railway Mechanical Engineer.*

Mr. Wright's Address

The International Railway Fuel Association can well be proud of its record. But it has a task before it compared to which its past achievements may be said to be little more than a scratching of the surface. The association has developed and placed on record facts as to how and where savings in fuel may be made. It has done much to supply the inspiration and develop the methods by which such savings were made effective; a great deal remains to be done, however, in these latter respects. The success of a fuel conservation campaign depends directly on the degree to which officers and men are inspired enthusiastically and faithfully to do their part as individuals.

Determining how and where the savings are to be made is largely an engineering problem. Getting the job done, however, demands a keen and thorough understanding of human nature, supplemented by the ability of a salesman or a promoter. It is not enough to attempt to educate men (I use this term to include both officers and men) as to the right way of doing a thing; some incentive must be offered to raise and maintain their interest at a high point. Men are not very different from children. Their attention is caught and retained for a while by one interest and then it restlessly moves on to another.

The men who are selling the idea of fuel conservation to their fellows in the organization must therefore not only study occasionally to change their methods of approach in order to maintain the interest of the men at a high point, but they must be so intimately in touch with the feelings of the men that they will guard against allowing the task to become arduous and will skillfully introduce into it all the spirit of playing a game. We have many experts to tell us how to conserve fuel down to the minutest detail. What we need is more promoters who can stir up enthusiasm and direct the energies of the officers and men along the right channels in carrying out these details.

For years many of us have felt that a large part of the problem of fuel conservation would be solved if we could develop some means of furnishing prompt and accurate records of fuel performance for each locomotive run. This looked most promising until we came to a fuller realization of the fact that almost every one on the railroad from the chairman of the board down to the call boy had some influence on the fuel performance. Why confine the measuring stick to the engine crew when so many other men enter into the problem of using fuel economically and efficiently?

While individual fuel performance records have their value, if they can be promptly and accurately obtained, would it not be better to get the whole team to work together as a unit to beat its own record, or that of its neighbors? The amount of coal used on a division and the train performance statistics can be determined fairly accurately. Two divisions may not be directly comparable, but suppose two divisions on the same or different roads, led in friendly competition by their superintendents, should try to see which one could make the best percentage of improvement. The idea is not new; its value in fuel conservation has been forcefully demonstrated within the past year.

When the fuel conservation promoter has this sort of a campaign going it will not be so necessary laboriously to teach the different men exactly how to do their part of the work. They will develop initiative and interest and will get after the expert or instructor rather than wait for him to get after them.

There is much indifference among the men in railroad service today. In the interests of the public the men, the management and the owners this must be overcome—and overcome quickly. One great difficulty in getting better results is that the men and officers are too far apart and do not really

know each other. If they did know each other better a lot of foolish misunderstandings would be wiped out. You can't carry out a program such as the one above mentioned without getting the men and the managements closer together.

There is another phase of the fuel conservation question which is deserving of special emphasis at this time. The Fuel Association is strong enough to take a real stand in attempting to correct some deep-seated abuses which reach back into the very heart of railway operation and management and bulk much larger than even the entire annual fuel bill of the railroads because they are a source of continuing waste not only in fuel but in other important items of cost of operation.

What will happen if instead of looking too intently upon fuel conservation as an end in itself we consider fuel performance as a barometer of efficient and economical operation? How many roads know what is the economical speed of a freight train over a given division? Why do they not know? It is comparatively easy to determine. How much can the capacity of a division be increased and the economy of operation be improved by modernizing the power? What will it mean if really adequate facilities are provided for keeping the cars and locomotives in first class operating condition? What a wonderful saving could be made in fuel and other operating expenses if some real brains and money were expended in providing business-like locomotive terminal facilities instead of having engine houses which without much imagination can be described as "dark holes with walls around them!" How do you know that a certain type and size of locomotive is best suited to the conditions on your road? You ought to know! Do your train despatchers ever get out over the division, or are they glued to office chairs with distorted visions or imaginations as to what is really going on over the division? You ought to be the fellows to help supply the dynamite to jolt them loose.

All these things and others which you will call to mind—which the association has fully recorded in its proceedings—will affect fuel consumption as much or far more than can be done by the average engine crew. The call today is for the Fuel Association with its great influence to go to the very roots in tackling the fuel conservation problem in a really big way. The conditions are ripe; now is YOUR opportunity! Will you grasp it?

H. B. MacFarland (A. T. & S. F.)
President

W. J. Bohan (Nor. Pac.)
Vice-President

J. B. Hurley (Wabash)
Vice-President

W. L. Robinson (B. & O.)
Vice-President

J. G. Crawford (C. B. & Q.)
Secretary-Treasurer

President MacFarland's Address

In his address Mr. MacFarland confined himself to matters pertaining to the welfare of the association, dwelling particularly on the increase in the cost of conducting the work of the association, the largest part of which is involved in the publication of the proceedings. In calling attention to the proposed increase of $1 a year in the annual dues, he reminded the members that the value of the proceedings is much more than the full amount of the dues. In referring to future work for the association, Mr. MacFarland suggested the development of a standard of fuel performance for locomotives. At the present time all fuel performance records are comparative, with no basic or potential standards, and he suggested the investigation of the possibility for the development of a formula for fuel performance in which

all the variables are included as factors, as an important subject for the consideration of a standing committee of the association.

REPORT OF COMMITTEE ON FEED WATER HEATING

The feed water heaters of today may be divided into the following general classes:

1. Waste gas heaters,
   a. Gas tube,
   b. Water tube.
2. Exhaust steam feed water heaters,
   a. Closed and open types.

The gas tube feed water heaters are used by the various railroads where the Mallet type locomotives have been developed. This type gives a rise in temperature of 70 deg. when new, but in bad water districts this efficiency is lowered rapidly, due to scale forming on the heater surface.

Very little has been accomplished with water tube heaters of the waste gas type, although it has been the subject of much experimental work. Waste gases passing through the front end will average about 600 deg. in temperature, but the rate at which heat can be transmitted from these gases to the feed water is so low that it necessitates a very large heating surface in the smokebox to utilize any appreciable quantity of this heat.

Tests have recently been run on the Santa Fe system with a feed water heater of the Thompson (front end, water tube) type. After this heater had been four months in service, tests were made. The rise in feed water temperature was 30 degrees. An examination of the heating surface showed that in the four months' time 1/16 in. of scale had formed on the feed water heating surface. Tests were also made at this time, using a pump in place of the injector, and approximately 70 deg. rise in temperature was secured. No facilities had been designed whereby the scale could be removed, so it was removed after this test was made.

With proper means for the removal of scale and sediment the waste gas heater can be made an effective instrument for the removal of scale forming ingredients and other impurities before they are carried into the boiler.

The exhaust type feed water heaters, due to the lower temperatures, made it practically necessary to use a steam pump in place of the injector. This type is very attractive, due to the fact that the transfer of heat from steam to a heating surface is about ten times that of the transfer of heat from waste gases. This allows a rather compact system and the feed water can be brought to within 10 or 15 deg. of the temperature of the exhaust steam.

The closed type of exhaust steam feed water heaters in use in this country are as follows:

Weir feed water heaters, two of which are installed for test purposes on the Southern Railway. The troubles to date with this system have been that the water hammering on the pipes between the pump and feed water heater causes leaks and the expansion and contraction in the feed water heater itself causes leaks between the copper tubes and cast iron tube plates. A re-designed heater has been planned so as to take care of this latter trouble.

The second feed water heater system of this type developed in this country is that manufactured by the Locomotive Feed Water Heater Company. This heater has been in service on the New York Central, the Delaware & Hudson, and the Delaware, Lackawanna & Western railways, and to date in the current year the following applications have been or are being made: Central Railroad of New Jersey, Fort Smith & Western, Canadian Pacific, Grand Trunk and Erie railroads. Additional equipments are being supplied to the Delaware & Hudson and the New York Central. The design is made so that the expansion and contraction of the brass tubes is taken care of so that no leakage occurs.

In order to increase the effectiveness of the heating surface in the brass tubes a corrugated spiral agitator of thin brass is placed in each tube. This agitator more than doubles the transfer of heat across each square foot of heating surface, and the high velocity and scouring action of the water caused by its presence tend to prevent lodgment of scale or dirt on the heating surface. Not the slightest particle of scale or dirt has ever been found in the heaters now in service. No experience, however, has been obtained from very bad waters.

The open type heater in service is the McBride feed water heater and pump, manufactured by the Worthington Pump & Machinery Corporation. There are four in service on the Pennsylvania on locomotives in service out of Altoona, Penn. These have been in service for about a year. The feed water heater and pump are combined and are designed for a capacity of 60,000 lb. of feed water per hour.

The exhaust steam passes through an oil separator enroute to the feed water heater. No trouble has been experienced so far from oil passing through the oil separator with the exhaust steam and being delivered to the boilers with the feed water. On road tests the increase in evaporation per pound of coal was 14.4 per cent for the heater.

The development of the locomotive feed water heater is not a question of theory, but of design. A locomotive feed water heater must be capable of continuous operation under the most adverse conditions; it must not add appreciably to the difficulty of controlling water supplied to the boiler at any required rate; it should not increase the weight on driving wheels to the extent that it becomes necessary to reduce the dimensions of the boiler, and it should be applicable to existing locomotives without necessitating radical alterations.

The substitution of a pump for an injector is the most difficult problem connected with the feed water heating. It complicates the control of boiler feed, increases locomotive maintenance and weight, and is in itself not as efficient nor reliable an instrument as the injector. On this account the success of a locomotive feed water heating hinges very largely on the design of a successful pump, unless a practical heater of the waste gas type can be designed which will raise feed water temperatures sufficiently to effect an appreciable saving with the use of an injector.

No great progress in feed water heating can be expected until the solution of the problem is actively taken in hand by the railroads with a determination to make feed water heating a practical operating factor. The committee urges that the mechanical department of each railroad endeavor to lead in this development. We should each endeavor to be a pioneer in the practical application of the feed water heater.

The report was signed by E. E. Chapman (chairman), A., T. & S. Fe.; E. A. Averill, Loco, Feed Water Co.; O. S. Beyer, Jr.; E. V. De Vilbiss, Penn. System; J. S. Hampson, Rosengrant Coal Co.; F. Kerby, B. & O.; Monro B. Lanier, Monroe-Warrior Coal & Coke Co.; L. G. Plant, *Railway Mechanical Engineer*, and L. R. Pyle, Loco, Firebox Co.

Discussion

E. A. Averill (Locomotive Feed Water Heater Company) stated that there are three essential considerations which must be taken into account in judging the practicability of feed water heater devices. These are (1) safety, (2) reliability and (3) cost of maintenance. Following the ability to meet the requirements of these three points the questions of efficiency, weight of apparatus and cost of installation should be considered. Feed water heaters of the exhaust steam type have now been developed so that the requirements of safety and reliability are fully met; and while installations are too

few to permit accurate figures to be obtained as to the cost of maintenance under conditions which would exist were large numbers of locomotives equipped, experience indicates that the requirements of low maintenance cost have been met satisfactorily.

During the discussion the point was brought out that a saving in fuel greater than could be expected from the actual amount of heat reclaimed was observed in some tests of heaters of the waste gas type. This was attributed to the improved combustion resulting from the decreased amount of fuel consumed, which was great enough to permit the firemen to do a better job of firing than had been possible without the heater.

POSSIBILITY OF LIGNITE COALS

BY S. M. DARLING
Fuel Engineer, United States Bureau of Mines

The nation's resources in the way of solid fuel, while large, are not inexhaustible. During the last twenty years the population of the United States increased 42 per cent, and during the same period our coal consumption increased 172 per cent. Our annual coal consumption in 1919 was about 530,000,000 tons. Should the same rate of increase hold for the next two decades, the consumption in 1940 would be over 1,400,000,000 tons. And it is quite probable that we shall be called on to export many millions of tons annually to South America, Africa and the Mediterranean.

The nation's coal resources of all ranks total 3,553,637,100,000 minable tons of 2,000 lb., nearly one-third being lignite. Of this lignite 964,424,000,000 is in North and South Dakota and northeastern Montana, approximately 23,000,000,000 tons in Texas, and 7,404,300,000 tons in Alaska, and relatively smaller quantities in several of the other Western and Southern States. The lignite tonnage given above includes only true lignite (as distinguished from sub-bituminous).

The Carbonizing Process

I came to the conclusion early in my lignite work that the large way to utilize this fuel was to carbonize it; that is, break it up into its four main divisions of gas, oils and tars, ammonia, and solid residue, the latter being practically charcoal. The fact that the lignite does not coke in the sense that bituminous coal cokes, but rather crumbles, on being carbonized, makes possible a continuous and comparatively inexpensive carbonizing process. The costly element of labor is reduced practically to that required for directing mechanical operations.

The Products of Carbonization of Lignite

(1)	Gas, per ton of lignite (440 B.t.u. per cu. ft.)	10,000 cu. ft.
(2)	Oil and tar	15 gal.
(3)	Ammoniacal liquor	65 gal.
(4)	Carbon residue	955 lb.

The Gas—Of the yield of 10,000 cu. ft. per ton of lignite carbonized, 6,000 cu. ft. are required to carry on the process, leaving a surplus, costing nothing, of 4,000 cu. ft. of 400 B.t.u. per cu. ft., or a total of 1,600,000 B.t.u. yielding 160 hp.-hrs. This power is comparable in cost with that derived from natural gas, and is fully as cheap as most hydroelectric power.

Oils and Tars—Just what is the most profitable disposition in this country for the oil and tar products remains to be determined. Their treatment and marketing is an industry by itself. It is not probable that Germany will ever again control the coal tar product industry, and it is not unreasonable to expect that in the future a large part of the demand for tar products will be supplied from our immense stores of lignite.

Ammonia—The ammonia is contained in the gas and gas water; it may be recovered as ammonium sulphate, a valuable fertilizer, as anhydrous ammonia for refrigeration and other commercial purposes, or it may be treated as a source of other nitrogen products, some of which are of vital importance in the manufacture of explosives.

Carbon Residue—Tests of *carbonized lignite*, for use in suction power-gas producers, in carload lots have proved it to be an exceptional and unexcelled fuel for this purpose. Its chemical composition, as shown by analysis, is about the same as that of Pennsylvania anthracite. For the production of power in this way carbonized lignite is fully equal to anthracite coal, charcoal, or bituminous coke, the standard fuels for such purposes. The carbonized lignite can also be burned satisfactorily on the automatic stokers and grates used to consume the smaller sizes of anthracite. *Carbonized lignite briquets* for domestic service have been made in carload lots, and, ton for ton, compare favorably with anthracite coal, and form an ideal domestic fuel in such rigorous climates as those of North Dakota and Alaska.

The territory naturally tributary to the Dakota lignite deposits embraces North Dakota, South Dakota and western Minnesota. Upwards of 2,000,000 tons of bituminous coal are shipped annually into that territory from Illinois, Indiana, West Virginia, Kentucky, and Pennsylvania. The average haul of this coal is 1,000 miles. If the Dakota lignite were put into stable and serviceable condition, by means of carbonizing and briquetting, this fuel demand could be supplied with an average haul of less than 400 miles. The average freight rate is about four mills per ton-mile. The tonnage mentioned does not include the anthracite shipped into this Dakota territory; this anthracite, carried in lake boats and distributed from the head of Lake Superior, amounts to about 1,500,000 tons annually.

To replace these 3,000,000 tons would require the carbonizing annually of 6,000,000 tons of lignite, yielding 3,000,000 tons of solid fuel, 18,000,000,000 cu. ft. of surplus gas (costing nothing), 45,000 tons of sulphate of ammonia, and 60,000,000 gallons of tar distillates. The Texas lignite situation affords an equally great opportunity for economic saving. And there are many smaller deposits of lignite scattered over the Southern and Western States, where relatively smaller savings can be made in similar fashion.

Preserve the Source of Lubricants

Bringing this lignite onto the market as fuel, with its attendant production of oils, would release large quantities of petroleum and natural gas for other uses. Of our original supply of petroleum, 42 barrels per capita have been used and only 70 barrels per capita remain for the future. About half of the petroleum currently produced is used as fuel for steam raising. The possibilities in the use of petroleum and its products in connection with the navy, airplanes, the merchant marine, automobiles, motor trucks and tractors are so great and vital that before long the use of oil for steam raising will be regarded as an inconceivable folly.

Mr. Requa, Consulting Engineer of the Bureau of Mines and Director of the Petroleum Division of the Fuel Administration, puts the situation in forcible language:

"The operation of hydroelectric generators, of railways and trolley cars, of the machinery of the factories, of internal-combustion engines, for our battleships and our merchant ships—in fact, of all machinery—is made possible by the use of one product, and of one product alone—petroleum. For if there is no known satisfactory substitute as a lubricant its exhaustion spells commercial chaos or commercial subjugation by the nation or nations that control the future source of supply from which petroleum will be derived."

The urgent necessity is upon us now to begin to bring these enormous stores of lignite into use and make them do their proper part of the economic work of the nation. The carbonizing of lignite will place the lignite-bearing regions substantially on a par as regards fuel and power with those parts of the country that are favored with bituminous and

anthracite coal. It will give an equally good domestic fuel in the way of carbonized lignite briquets, better gas, producer fuel in the form of carbonized lignite, enormous quantities of gas to be used for fuel or power purposes, a large tonnage of fertilizer in the form of sulphate of ammonia, and a great amount of oils and tars.

Discussion

The discussion centered around the possibilities of using lignite coal in locomotive service and it was pointed out that the development of the use of lignite briquets depends on the building up of a market for the by-products. The experience in the by-product coke industry in the East indicates that this will be a process requiring considerable time. As an immediate means of making these coals available the possibility of using them in pulverized form has received considerable attention. Comparing the possibilities for the use of pulverized lignite with the bituminous coals from the Eastern and Central fields burned on grates, it was pointed out that the average saving in freight alone would amount to about $1.60 per ton, while the cost of preparing the pulverized fuel, on the basis of a plant having a capacity of 1,000 tons a day, would amount to about 40 cents a ton delivered to the locomotive tender. This includes the interest, depreciation, taxes and insurance on an investment of $250,000 required to install such a plant. In experimental work it has been possible to pulverize lignite with as high as 18 to 22 per cent moisture remaining in it. If this practice proves to be feasible commercially, it will eliminate the necessity for a drier of large capacity and the danger of combustion from the high temperature required in the drier to reduce the moisture to the low percentage ordinarily considered necessary in pulverized fuel practice.

The discussion also brought out the fact that some lignites can be burned in their natural form. This is being done very successfully on the Oregon-Washington Railroad & Navigation Company's line. The coal used is a black lignite or sub-bituminous with a heating value of less than 9,000 B.t.u. and 18 per cent moisture. To burn this coal, locomotives are built with large grate area and a large netting area in the front end. An unusually large exhaust tip is used and about one-third of the air is admitted over the fire through a baffle fire door. Because of the comparatively small amount of combustible in this fuel, it requires much less air per pound than the higher grade bituminous coals.

SANTA FE LOCOMOTIVE OIL BURNING PRACTICE AND FUEL PERFORMANCE*

BY WALTER BOHNSTENGEL
Assistant Engineer Tests, A. T. & S. F.

The Santa Fe System has approximately 3,160 locomotives, of which two-thirds use coal and one-third use oil as fuel.

The necessary procedure in converting a coal burner to oil is providing an oil tank of proper shape and size to fit the coal space in the water tank; removing grates, ash pan, and ash pan rigging and applying a fire pan with proper brick lining and burner; and arranging necessary piping on the tender and boiler back head of the locomotive, to regulate the oil outflow to the firebox. All pipe and pipe fittings should be extra heavy, the valves and throttle being of heavy design capable of carrying a maximum pressure of 250 lb.

Firebox and Flues

It has been demonstrated that button head radial stays should be eliminated and taper head radial stays applied. It is the practice to have all rivets countersunk and driven flush. It is also considered good practice to scarf the door and flue sheet flange from the inner edge of the rivet hole to the outer edge of sheet, making the outer edge approximately 3/16 in. thick to prevent undue cracking from the rivet hole to the edge of sheet. It is not considered that firebox troubles are any greater in oil burning locomotives than in coal burners in proportion to the work performed. The troubles experienced in oil burning locomotives consist of cracks developing in the knuckle of the fire door hole, top flange of door sheet and flue sheet, leaky radial stays and staybolts, as well as cracks developing from staybolt to staybolt in the side sheet. Prompt and careful attention is necessary in boiler washing.

Should the side, flue or door sheets have patches applied by rivet or patch bolts, they are liable to give considerable trouble, and should the fireboxes be of the five-piece type, the longitudinal seams in the crown sheet would cause considerable trouble from leaking. It is Santa Fe practice to cover these seams with brick until they require renewal.

The life of a firebox and a set of flues is somewhat less in an oil burning locomotive than in a coal burning locomotive. The average for all locomotives, old and new, large and small, in all classes of service, shows that the life of staybolt fireboxes in coal is 10 years and 3 months and in oil 9 years. This cannot be used to predict the actual probable life of any one box, as the figures vary to a certain extent by reason of different local conditions. The average life of a set of flues in an oil burning freight locomotive is about 48,000 miles, and in a coal burning locomotive, same service about 65,000 miles. The life in passenger service is approximately 40 per cent higher and in about the same relation.

Engine Equipment

The Booth burner is used as standard on the Santa Fe. The patent on this burner expired in February, 1912, and it is made and tested in our own shops. Good results are obtained from 1½-in. burners on small locomotives, while the larger power is provided with 2 and 2½-in. burners. For the Mid-Continent oil, a 1½-in. pipe is used to convey the oil from the tank to the firebox, while with California and Mexican oil 2-in. piping is used to the firing valve.

The larger locomotives having 8,500 and 9,000-gallon water tanks, use an oil tank of about 3,400-gallon capacity. On the smaller locomotives having 5,000 and 6,000-gallon water tanks, the capacity of the oil tank varies from 1,800 to 2,250 gallons.

Comparison of Coal and Oil

The essential features in preparing to burn oil for locomotive fuel is the availability, extent of supply, and relative value of the oil, not at the well, but at the point of consumption.

The coal used on Santa Fe locomotives averages 11,500 B.t.u. and the oil 19,000 B.t.u. per lb. On this basis the theoretical heat value of one pound of oil equals 1.65 lb. of coal. After the ratio of coal to oil is obtained to agree with local conditions, the advantages to be gained by the use of oil may be considered by substituting in the following formula:

$$e = \frac{a \cdot b \cdot c \cdot d \cdot X}{2000} = \text{equivalent price of oil per barrel.}$$

$$d = \frac{2000 \cdot e}{a \cdot b \cdot c \cdot X} = \text{equivalent price of coal per ton.}$$

a = Weight of oil per gallon pounds = specific gravity of oil times weight in pounds of one gallon of water.
b = Number of gallons per barrel.
c = Ratio of heating value of oil to that of coal in B. t. u.
d = Price of coal per ton, dollars.
e = Price of oil per barrel, dollars.
X = Ratio of boiler efficiency, oil to coal.

The results of a number of recent tests on the Santa Fe show that the evaporate efficiency of oil is about 25 per

*A., T. & S. F. locomotive equipment for burning oil was described and illustrated in a paper read before the 1915 convention, an abstract of which will be found in the June, 1915, issue of the *Railway Age Gazette, Mechanical Edition*, page 280.

cent more than coal for hand fired and 40 per cent more than coal for stoker fired locomotives, that is, the factor X is 1.25 for hand fired and 1.40 for stoker fired locomotives.

The cost of changing a locomotive from coal to oil burning depends largely on the size of the locomotive. Recent figures show that the approximate cost of changing a modern locomotive of Pacific, Mikado or Atlantic type is from $2,400 to $2,500, including the construction of an oil tank, draft pan, petticoat pipe, oil burner piping, fittings, etc. This cost would also include the application and the usual overhead charge. A smaller locomotive, such as the eight and ten wheelers, can be converted at a cost of about $1,800 to $2,000 each.

Either the speed of the train or the tonnage is increased on an oil burning locomotive, due to the locomotive being worked to its maximum capacity at all times. A test made in 1919 shows that an oil burning Atlantic type locomotive handled an average tonnage of 750 tons, while the same kind of a coal burning locomotive handled 578 tons in the same class of service.

The Brick Arch in Oil Burning Locomotives

The paper also contains a report of tests on three oil-burning locomotives of the 2-10-2 type, all of the same class, to determine the effect of an arch tube supported brick arch on fuel performance, with the standard location of the oil burner at the front end of the firebox as well as at the rear of the firebox. These two arrangements were compared with the standard firebox arrangement, which does not include a brick arch.

The data for the individual runs during these tests, as well as the average, show a slightly better fuel performance for the locomotives without the arch than for those with a brick arch. However, the atmospheric temperature averaged slightly higher during the runs made without the arch than for those with the arch, which would be favorable to the former in a lower radiation loss.

The data show no saving in fuel, if anything a lower efficiency for the arch, in comparison for the present front end burner arrangement without arch. This can be explained by noting that with proper drafting, without arch as well as with arch, the locomotive can be fired without showing smoke, and having as low a front end temperature without as with the arch. Obtaining complete combustion in the firebox in either case, further economy could only be obtained by absorbing more of the heat from the gases and getting a lower front end temperature. Another explanation for lower efficiency of the arch with oil, is that radiant heat is not utilized to the best advantage with an arch, as the arch shades part of the firebox.

As a general conclusion, taking the present standard arrangement with front end burner and no arch or arch tubes as a basis, the data secured on these tests show that the advantages resulting from the use of an arch tube supported arch with either the front or back end burner arrangement are more than offset by disadvantages and, from these tests, the installation and maintenance of the arch cannot be justified in oil-burning locomotives.

GENERAL SUMMARY OF OIL BURNING TESTS, WITH AND WITHOUT BRICK ARCH

	East Bound				West Bound			
Firebox arrangement	A	B	C	D	A	B	C	D
Number of runs	5	11	4	3	5	10	4	3
Running time, hours	8.35	8.42	8.57	8.15	6.42	6.35	6.25	6.17
Dead time, hours	2.47	3.15	2.62	2.79	2.58	2.95	2.97	2.72
Total time, hours	10.82	11.57	11.18	10.94	9.00	9.30	9.22	8.88
Total oil fired, pounds	25,770	26,970	26,630	26,420	9,550	12,430	11,390	11,160
Total water evaporated, pounds	287,150	293,440	292,140	284,720	108,430	134,940	124,930	119,520
Ratio, water to oil	11.14	10.86	10.98	10.77	11.35	10.86	10.97	10.72
Draft, in. of water:								
Fire pan	....	5.0	7.0	7.5	....	3.8	5.3	5.5
Smoke box	11.2	10.3	11.8	12.5	6.3	7.3	8.5	8.7
Temperature, deg. F.:								
Feed water	75	69	68	63	64	58	58	53
Smoke box	634	643	601	595	525	549	541	548
Fuel oil	117	119	119	113	119	121	127	119
Atmosphere	65	55	53	38	64	52	54	37
Tonnage per train	1,307	1,213	1.353	1,217	1,021	1,364	1,346	1,221
Gross thousand ton miles	191.5	180.9	190.0	181.2	147.2	211.7	200.8	181.8
Speed, miles per hour	17.9	17.8	17.4	18.4	23.4	23.6	24.0	24.3
Oil, pounds per gross thousand ton miles	134.6	149.2	140.1	145.7	65.8	61.6	57.1	61.6
Water, pounds per gross thousand ton miles	1,520	1,660	1,582	1,592	782	699	652	710
Equivalent evaporation:								
Pounds water per pound oil	14.60	14.40	14.47	14.26	14.55	14.14	14.25	14.06
Thermal efficiency, per cent:								
Boiler and superheater	76.4	75.3	75.6	74.5	76.0	74.0	74.5	73.5

All runs were made between Needles, Calif; and Seligman, Ariz., 149 miles.
Firebox arrangements:
A = Without arch tubes or arch; burner at the front end of the fire pan.
B = With arch tubes and arch; burner at the back end of the fire pan.
C = With arch tubes but no arch; burner at the front end of the fire pan.
D = With arch tubes and arch; burner at the front end of the fire pan.

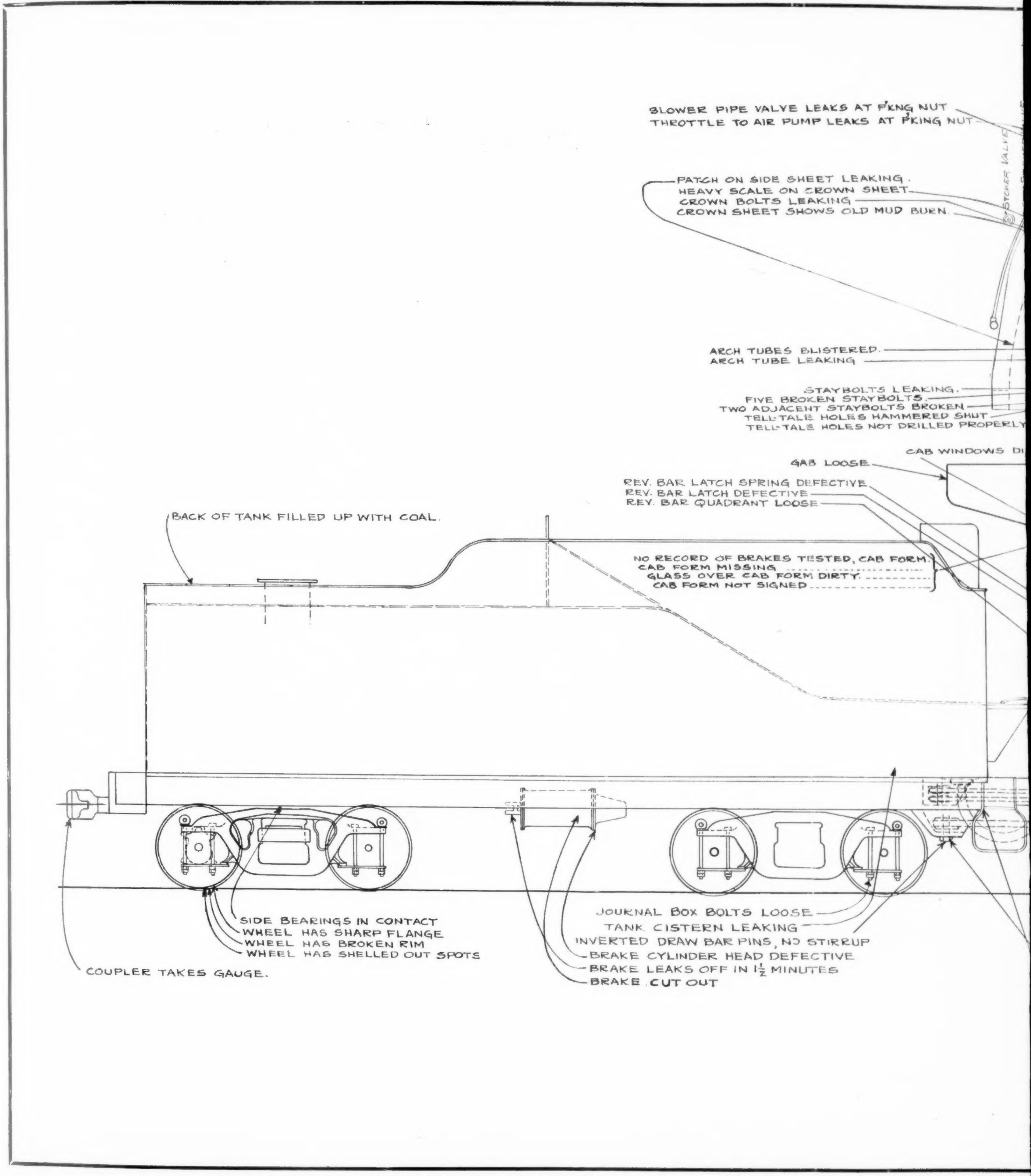
Discussion

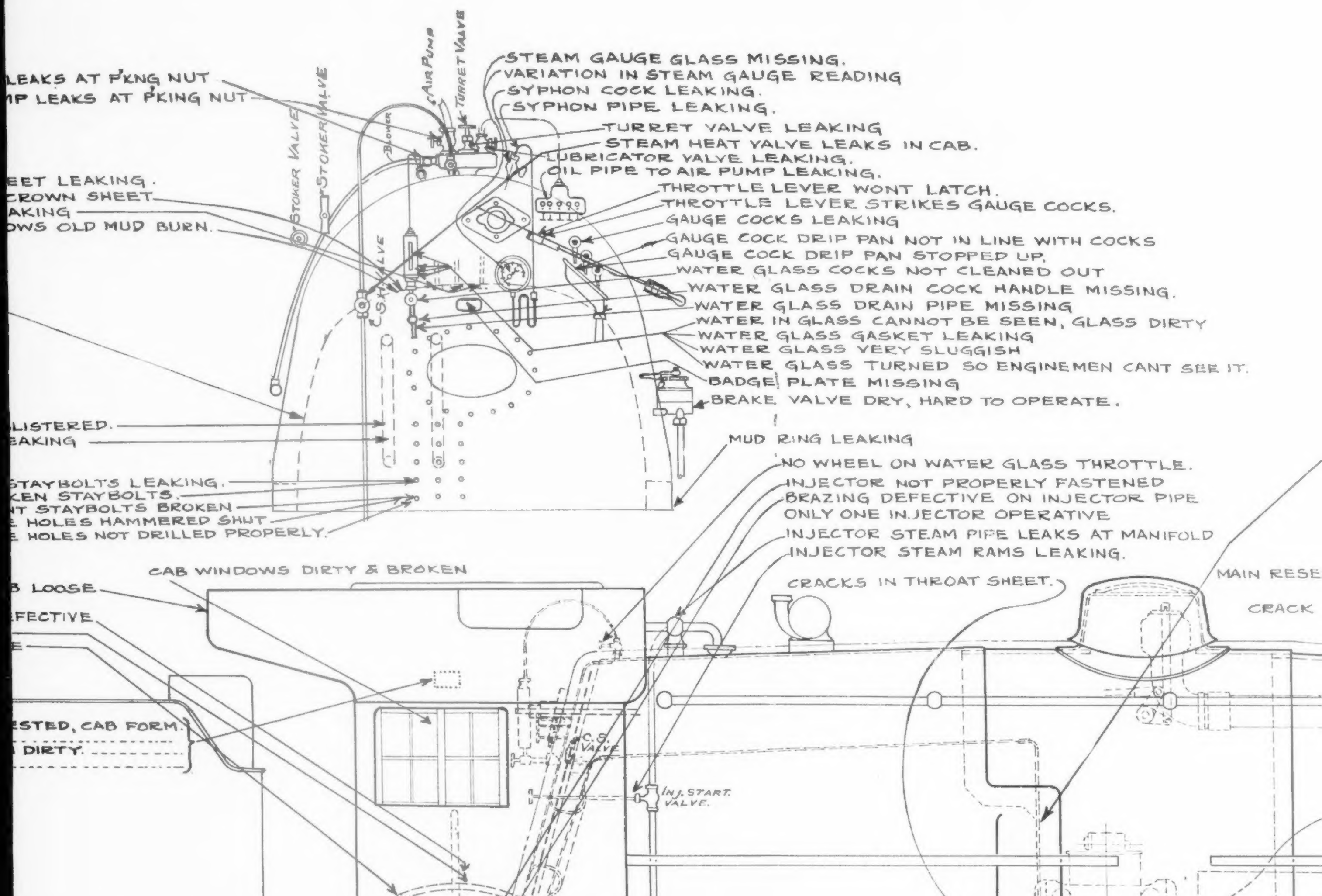
The discussion centered around the difficulty resulting from the accumulation of carbon on the bottom of the draft pan in front of the oil burner on oil-burning locomotives. This is being experienced in some cases where oil has only recently been adopted as locomotive fuel, especially where the heavy gravity Mexican oils are in use. On roads which have had considerable experience, the difficulty has been overcome, largely by care in the location of the burner, to keep the flame properly centered in the firebox and away from the bottom of the pan, and by admitting air around the burner, principally under and at the sides of the burner.

In discussing the Santa Fe arch tests, J. T. Anthony stated that experience on other oil-burning roads indicates a saving of from five to eight per cent where the arch is used. He took exception to the statement that the arch tended to shield part of the firebox from direct flame radiation, as the temperature of the arch makes it a radiating medium itself. He admitted that where a boiler efficiency as high as 76 per cent was obtained without the arch there was not much range for improvement left for the arch, but doubted the ability, day in and day out, to maintain such a high efficiency.

REPORT ON FRONT ENDS, GRATES AND ASH PANS

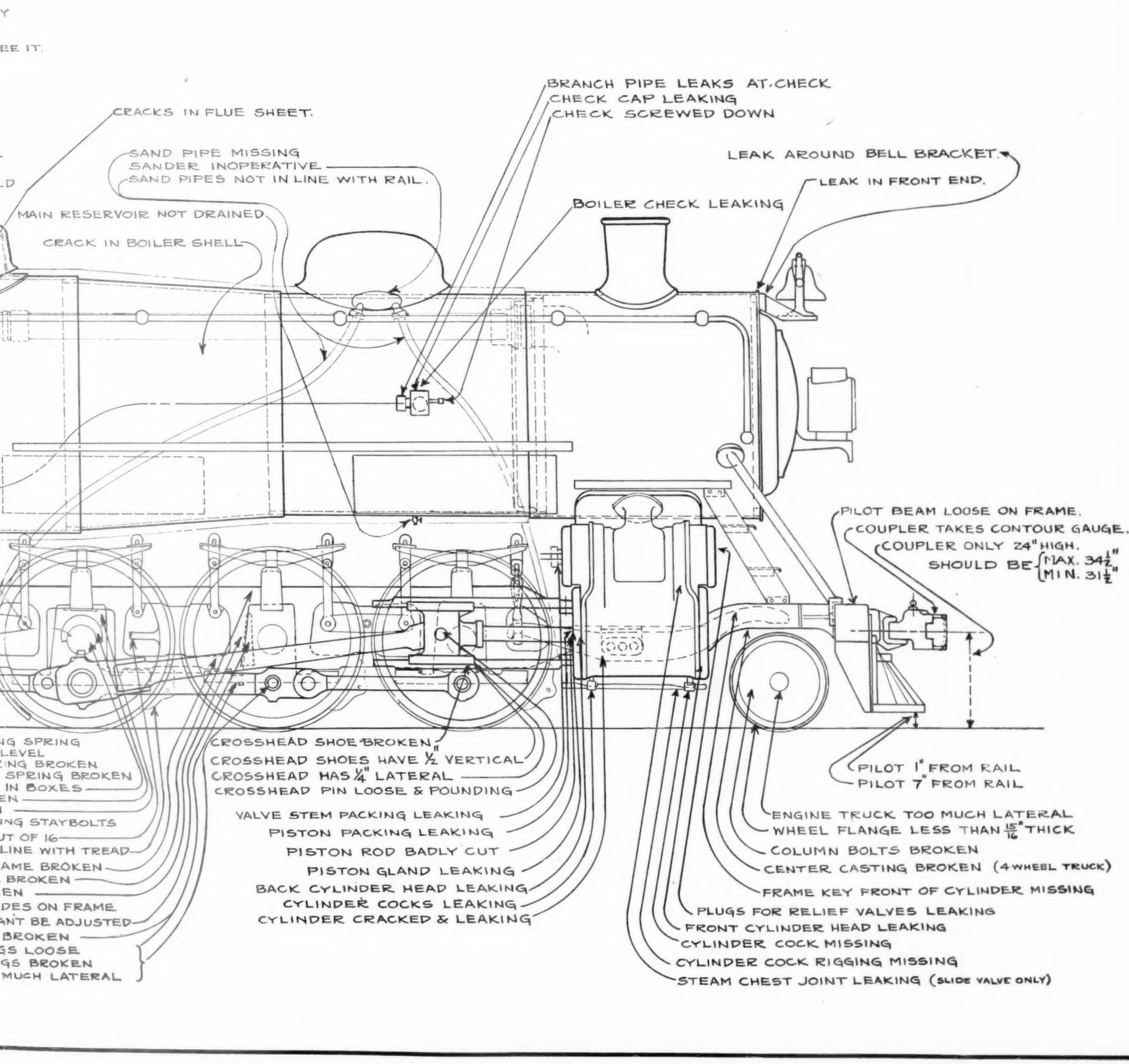
The committee presented data for comparison of two types of grates from tests of two classes of coal, namely, Gallup and Kansas on the Santa Fe. The object was to determine what, if any, saving could be effected by using table grates in place of finger grates in locomotives burning Gallup coal. This coal, obtained from Gallup, New Mexico, is a semi-bituminous coal, having the following analysis:


BLOWER PIPE VALVE LEAKS AT P'KNG NUT
THROTTLE TO AIR PUMP LEAKS AT P'KING NUT
PATCH ON SIDE SHEET LEAKING.
HEAVY SCALE ON CROWN SHEET.
CROWN BOLTS LEAKING
CROWN SHEET SHOWS OLD MUD BURN.
ARCH TUBES BLISTERED.
ARCH TUBE LEAKING
STAYBOLTS LEAKING.
FIVE BROKEN STAYBOLTS.
TWO ADJACENT STAYBOLTS BROKEN
TELL-TALE HOLES HAMMERED SHUT
TELL-TALE HOLES NOT DRILLED PROPERLY
CAB WINDOWS DI
CAB LOOSE
REV. BAR LATCH SPRING DEFECTIVE
REV. BAR LATCH DEFECTIVE
REV. BAR QUADRANT LOOSE
BACK OF TANK FILLED UP WITH COAL.
NO RECORD OF BRAKES TESTED, CAB FORM.
CAB FORM MISSING
GLASS OVER CAB FORM DIRTY
CAB FORM NOT SIGNED
SIDE BEARINGS IN CONTACT
WHEEL HAS SHARP FLANGE
WHEEL HAS BROKEN RIM
WHEEL HAS SHELLED OUT SPOTS
COUPLER TAKES GAUGE.
JOURNAL BOX BOLTS LOOSE
TANK CISTERN LEAKING
INVERTED DRAW BAR PINS, NO STIRRUP
BRAKE CYLINDER HEAD DEFECTIVE
BRAKE LEAKS OFF IN 1½ MINUTES
BRAKE CUT OUT


STOKER VALVE
STOKER VALVE
AIR PUMP
TURRET VALVE
BLOWER
STEAM GAUGE GLASS MISSING.
VARIATION IN STEAM GAUGE READING
SYPHON COCK LEAKING.
SYPHON PIPE LEAKING.
LEAKS AT P'KNG NUT
MP LEAKS AT P'KING NUT
TURRET VALVE LEAKING
STEAM HEAT VALVE LEAKS IN CAB.
LUBRICATOR VALVE LEAKING.
OIL PIPE TO AIR PUMP LEAKING.
EET LEAKING.
CROWN SHEET
AKING
OWS OLD MUD BURN.
THROTTLE LEVER WONT LATCH.
THROTTLE LEVER STRIKES GAUGE COCKS.
GAUGE COCKS LEAKING
GAUGE COCK DRIP PAN NOT IN LINE WITH COCKS
GAUGE COCK DRIP PAN STOPPED UP.
WATER GLASS COCKS NOT CLEANED OUT
WATER GLASS DRAIN COCK HANDLE MISSING.
WATER GLASS DRAIN PIPE MISSING
WATER IN GLASS CANNOT BE SEEN, GLASS DIRTY
WATER GLASS GASKET LEAKING
WATER GLASS VERY SLUGGISH
WATER GLASS TURNED SO ENGINEMEN CANT SEE IT.
BADGE PLATE MISSING
BRAKE VALVE DRY, HARD TO OPERATE.
LISTERED.
EAKING
MUD RING LEAKING
NO WHEEL ON WATER GLASS THROTTLE.
STAYBOLTS LEAKING.
KEN STAYBOLTS.
NT STAYBOLTS BROKEN
E HOLES HAMMERED SHUT
E HOLES NOT DRILLED PROPERLY.
INJECTOR NOT PROPERLY FASTENED
BRAZING DEFECTIVE ON INJECTOR PIPE
ONLY ONE INJECTOR OPERATIVE
INJECTOR STEAM PIPE LEAKS AT MANIFOLD
INJECTOR STEAM RAMS LEAKING.
CAB WINDOWS DIRTY & BROKEN
B LOOSE
EFECTIVE
E
CRACKS IN THROAT SHEET.
MAIN RESE
CRACK
ESTED, CAB FORM.
DIRTY.
C.G. VALVE
INJ. START. VALVE.
TRAILER TOO MUCH LATERAL
TRAILER BOLTS LOOSE
ASH PAN RIDES BRAKE RODS
TAIL BRACE LOOSE
CHAFING CASTING LOOSE
CAB APRON NOT LEVEL
CAB APRON NOT ROUGHENED
SPRING BUFFERS NOT IN CONTACT
8" SLACK IN SAFETY CHAINS
NO COTTERS IN DRAW BAR PINS
TANK HOSE LEAKING
TANK SILL IN BAD CONDITION
STIRRUP
CTIVE
TES
BAND WORN OFF DRIVING SPRING
DRIVING SPRINGS NOT LEVEL
ONE LONG LEAF IN SPRING BROKEN
TWO SHORT LEAVES IN SPRING BRO
EXCESSIVE LATERAL IN BOXES
CROWN BRASS BROKEN
DRIVING BOX BROKEN
DRIVING WHEEL CUTTING STAYBOLT
6 SPOKES BROKEN OUT OF 16
BRAKE SHOE NOT IN LINE WITH TR
BOTTOM RAIL OF FRAME BROKEN
TOP RAIL OF FRAME BROKEN
FRAME LEGS BROKEN
SPRING HANGER RIDES ON FRAM
WEDGE BROKEN CAN'T BE ADJUS
PEDESTAL BOLTS BROKEN
BUSHINGS LOOSE
BUSHINGS BROKEN
BUSHINGS TOO MUCH LATER

I. C. C. Locomotive Defects

Chart showing common defects of locomotives which constitute violations of the federal locomotive inspection law. The existence of any such defects is sufficient cause for removing the locomotive from service. Prepared by L. S. Cunningham. Copyright, 1920, by Simmons-Boardman Publishing Company.



Moisture, per cent	8.25
Volatile matter, per cent	29.91
Fixed carbon, per cent	51.46
Ash, per cent	10.38
Sulphur, per cent	0.64
Calorific value of coal as received B. t. u., per pound	11,484
Calorific value of dry coal, B. t. u. per pound	12,516

The test was made between Belen and Gallup, New Mexico, in May, 1919. The locomotive used for this test is a single expansion Mikado type equipped with a Duplex stoker and superheater. It was new, having just been received from the Baldwin Locomotive Works. The front end draft arrangement and the brick arch arrangement remained the same, and in the comparison of data of finger and table grates the same fireman was used throughout the test.

The standard finger grates for Gallup coal were installed first, and the brick arch maintained eight bricks high in the center and intermediate rows and seven on the side rows, and all set down against the tube sheet. With Gallup coal, it has been found most economical to run the arch down against the flue sheet and at least seven courses high, on account of stack losses. The standard Gallup coal grates have 5-in. openings between the fingers, while the clearance between the bars on the table grates is 3/4-in. with 5/8-in. slots for air passage up through the bars. The percentage of air opening is approximately 37.8 per cent with either design.

The locomotive was run with full compensated tonnage rating, namely, 2,300 tons, Dalies to Gonzales, and 2,700 tons, Gallup to Gonzales.

The million-foot pounds of work done at the drawbar indicated a higher average drawbar pull, a greater amount of total work done, as well as a greater amount of work per hour while working steam with the table grates than with the finger grates. This is the reason for the table grates using more coal and giving poorer evaporation than the finger grates, as the harder the locomotive is worked, particularly where there is much fine coal or slack, the greater the stack loss.

The table grates do not drop any fire and very little ash except when being shaken, while the finger grates drop considerable fire in certain portions where the fingers are cut short to clear obstructions in the corners of the firebox. The shape of the pan (the high sides) causes the hot ashes and fire to sweep up along the side of the cab into the enginemen's faces when a high side wind is blowing. The table grates were very popular with the enginemen on this account; also, on account of being easier to shake. There is very little need of a power grate shaker with table grates and Gallup coal.

Aside from the coal being a little finer and the locomotive being worked a little harder on trips with the table grates, which incurs a greater stack loss, it is possible that the larger coal consumption with the table grates is due to insufficient air admission. While the air openings are calculated to be the same, the ashes or contents of the firebox pack down over the slots in the table grates and there is not the same chance to loosen it up by shaking as with the finger grates. The steaming of the locomotive was about the same with the table grates as with the finger grates.

When all things are taken into consideration, the saving in coal of table grates over the standard Gallup coal finger grates, or vice versa, is very small. Under certain conditions one will show a saving, while under other conditions the other grates may show a saving.

A similar test was made on the road between Argentine and Emporia, Kansas, a distance of 108 miles, with Kansas coal. The same type of locomotive, No. 3209, was used on this test as with Gallup coal and with the same equipment.

The data on the table grates were obtained for the most part by an observer on the locomotive after the test with the dynamometer car had been finished. On most of the trips with the observer on the locomotive, a test on a perforated arch in comparison with the standard seven course arch was carried at the same time. However, the results indicate that the perforated arch cut a very small figure in the saving.

Evaporation is the proper basis on which to make a comparison between table and standard grate. From a summary of dynamometer car data there was shown to be an average saving for the round trip of 8.0 per cent. Based on tests without the dynamometer car the saving averages 10 per cent for the round trip. Under all conditions there was some saving in favor of the table grates, and a conservative estimate would be from 1 to 1 1/4 tons of coal per trip.

The table grates save coal by preventing it from falling through into the pan only partly burned. The loss from this source is very noticeable with the coarse grates now used, particularly when the coal is fine and starting out of a terminal when the fire is light. Part of this loss could be eliminated by using finger grates with fingers closer together, such as those used for Gallup coal.

There is a considerable loss due to finger grate bars having to be replaced on account of fingers being burned off which loss would probably not be so great with the table grates.

SUMMARY OF THE GALLUP COAL TESTS

	Equated gross 1,000 ton miles	Ratio water to coal		Average boiler pressure, lb.	Coal, lb., per 1,000 ton mile, Belen and Gallup	Water, lb., per 1,000 ton mile, Belen and Gallup	Mileage		Drawbar pull lb.—average		Million ft. lb. of work				Pounds per million ft. lb.		Duration of test		Speed, m. per hr.
		Belen and Suwanee	Suwanee and Gallup				Over division	Working steam	Over division	Working steam	Average per mile: Over division	Average per mile: Working steam	Acerage per hr. working steam	Total	Coal	Water	Dead time hr., min.	Running time hr., min.	
West Bound—Belen to Gallup, 144.1 miles																			
A......	323	4.97	5.18	188	162.8	843	145.40	111.36	20,988	27,421	110.82	144.78	2196	16,112	3.26	16.9	3-48	8-57	16.1
B......	318	4.51	4.91	187	179.9	881	145.64	113.31	21,384	27,474	112.91	145.06	2475	16,443	3.47	17.0	2-47	8-10	17.7
C......	322	4.92	4.96	188	181.8	902	145.47	113.28	22,266	28,608	117.57	151.05	2314	17,102	3.43	17.0	4-11	8-58	16.2
East Bound—Gallup to Belen, 144.5 miles																			
A......	389	...	5.31	187	75.8	402	145.61	51.08	9,996	28,499	52.78	150.48	1951	7,685	3.84	20.3	2-18	7-33	19.1
B......	389	...	5.03	187	82.2	413	145.48	55.10	10,054	26,586	53.09	140.37	1869	7,723	4.14	20.9	1-35	7-35	19.0
C......	396	...	5.01	187	79.9	398	145.69	53.17	10,303	28,231	54.40	149.06	1988	7,926	3.98	19.9	1-34	7-38	19.0

NOTE—"A" is the average of five trips in each direction, with finger grates and an eight course arch. "B" is the average of two trips in each direction with finger grates and a perforated arch. "C" is the average of three trips in each direction with table grates and an eight course arch.

Front Ends

During the testing of the Mikado type Locomotive 3209 just referred to, a variable exhaust nozzle designed by Mr. Stevens, a boiler maker on the Santa Fe, was applied for test. This device can be regulated from the cab and gives a discharging area equal to a nozzle area anywhere between 5 1/2-in. and 6-in. diameter. The idea of the inventor was to open up this nozzle when the locomotive was steaming

freely and to close it down at gradients of 1/16 in. when for any reason the locomotive did not steam so freely.

When first applied, in February, 1919, no difference could be detected in fuel consumption, and it was found necessary to put a diamond split in the top. However, as weather conditions got better, the nozzle was run practically wide open all the time. In its operation the nozzle was run either wide open or closed. The specific gradations in closing were not utilized by the enginemen. The chief disadvantage of the variable exhaust nozzle is that if not worked frequently it becomes inoperative in a short time by being stuck up due to the exhaust gases.

At the fourth annual convention in 1912, an exhaustive paper was presented to this association showing the great possibilities in fuel saving and the further possibilities of increasing the power of locomotives by the elimination of back pressure. Information now comes to the committee that a simple and effective drafting system has been developed based on the fundamental assumption in the paper on back pressure, previously referred to, that there was sufficient energy in the exhaust steam to draft the locomotive with a maximum of four pounds back pressure on the cylinders.

The essential features of this system are an exhaust volume chamber and a governing variable exhaust nozzle which opens under very low static pressure and which has a variable opening with each exhaust blast. The variable opening and constant automatic agitation of the wings is most essential in maintaining a variable exhaust nozzle.

In the committee's last report attention was called to the Master Mechanics' formulæ for the design of stack and front end, showing that they are not properly applicable to present power. The Lewis drafting system, with its exhaust blast of very large contact area of steam and exhaust gases, and its unusually large stack, are convincing testimonials that we should no longer abide by this rule of thumb design, but that we should make investigations to find the limit of design which will give the greatest efficiency of the exhaust blast.

The report was signed by H. B. MacFarland (chairman), A. T. & S. F.; W. J. Bohan, Nor. Pac.; E. B. DeVilbiss, Penn. System; J. P. Neff, American Arch Co.; Frank Zeleny, C. B. & Q., and C. C. Higgins, St. L.-S. F.

USE OF CARBOCOAL ON LOCOMOTIVES

BY GEORGE E. SCHERICK, JR.
Fuel Engineer, International Coal Products Corporation

In the firing of bituminous coal many schemes have been tried to promote better efficiency and some of these have met with considerable success. But in spite of all attempts toward better economy the locomotive boiler remains today one of the chief offenders in the extravagant use of fuel. There can be no doubt that the continued demand of the public for abatement of the smoke nuisance will force the railroads to the use of a smokeless fuel or to electrification of their roads in their larger terminals. The limited supply of anthracite in the country makes it unlikely that anthracite can be used generally on railroads, and it is evident that there is a good field for a fuel comparable to anthracite but manufactured from bituminous coal, with a saving of the valuable by-products.

Carbocoal is a dense, smokeless fuel formed by carbonizing bituminous coal. Any coking or non-coking bituminous coal or even lignite can be used in the process, although some coals are more desirable than others. Carbocoal compares very favorably with anthracite coal and has about the same analysis, but it burns with a much less draft. It is manufactured from bituminous coal by carbonization in two stages. The raw coal is first crushed and then fed continuously to horizontal retorts, operated at a relatively low temperature. The volatile matter in the coal is reduced to about eight per cent. This low temperature coke or semi-carbocoal is then ground, briquetted with pitch, and the resulting briquets are carbonized at a temperature corresponding to that used in coke ovens, the by-products again being collected as in coke-oven practice.

The resulting briquet is a smokeless fuel resembling anthracite in its properties and differing considerably from ordinary coke, particularly in that it is a soft form of carbon and much more free burning than coke.

Several carbocoal tests have been made by various railroads in the east, and the results as a whole have been very satisfactory, especially as these tests can only be considered of a preliminary nature.

The first test run on a locomotive with carbocoal as fuel was made on May 21, 1917, and was run to ascertain the possibilities and flexibity in handling when fired on a regular locomotive grate with its draft system. The engine (a switch engine) was equipped to burn anthracite, fuel oil or bituminous coal, and as reported by the superintendent of motive power of this railroad, who was keeping a close watch of this locomotive throughout the day, "the performance on the road was better than with either hard or soft coal. The engine steamed more freely and the fire could be kept in more satisfactory condition, as the briquets did not clinker at all but simply burned up to a fine ash which could be shaken through the grates. In this respect it was superior to any of our ordinary fuel."

It was necessary to shake the grates only four times from the time the fire was originally built. At no time during the test could any smoke be detected coming from the stack. The briquets, despite the many times they had been shoveled from the period following their manufacture to the time they rested in the tender, appeared without any mutilation and with a marked absence of slack and fines. No difficulty was experienced in maintaining a full head of steam. On six occasions it was necessary to start the blower on the engine, whereas the engine crews stated that with coal as a fuel on this particular work it was necessary to keep the forced draft in operation the greater part of the day.

In September, 1917, the Carolina, Clinchfield & Ohio ran a series of two tests with carbocoal. These were run over the same road from Kingsport to Soldier, a distance of 22 miles, with 43, 50-ton cars in the train, and as far as was feasible external conditions were kept constant. No instructions were given the fireman as to the proper methods of handling carbocoal. There was no opportunity to try out the fuel in advance. The firemen in this locality were accustomed to firing high volatile bituminous coal, while the carbocoal corresponds in many ways to anthracite coal.

CAROLINA CLINCHFIELD & OHIO TEST OF CLINCHFIELD CARBOCIAL

Type of locomotive	2-6-6-2
Weight, total engine, lb.	378,650
Tractive effort, lb.	77,400
Grate area, sq. ft.	78
Heating surface, sq. ft.	5,752

Data ard results	Run 1	Run 2	Average
Grade, compensated, per cent	0.5	0.5	0.5
Length of route, miles	18	22	20
Tons behind tender	3,022	2,981	3,001
Pull on drawbar (calculated)	43,000	42,250	42,275
Average speed, miles per hour	9.0	10.1	9.55
Fuel burned, sq. ft. grate area, per hour	64.0	98.0	81.0
Water evaporated per sq. ft. heating surface, hr.	6.75	9.70	8.22
Water evaporated per pound of coal	7.77	7.30	7.53
Equivalent evaporated per pound of coal	9,36	8.83	9.09
Fuel consumed per ton mile, train load	.184	*.250	.217

*Allowance has been made for fuel due to safety valves being open at least 19½ min.

In addition to these tests a demonstration was made on the Baltimore & Ohio. This demonstration was witnessed by some of the leading citizens of the community in which it was made, and gave entire satisfaction as a smokeless fuel.

Carbocoal can be stored in unlimited quantities without danger of fire from spontaneous combustion. The storage space per ton for carbocoal is but a few per cent greater than

for coal; further, the carbocoal does not weather and slack as many coals do on storage.

Discussion

Several inquiries were made relative to the commercial possibilities to the railroads and the cost of production. The first commercial plant will commence operation in the Clinchfield district in July and no production costs are available. An estimated investment of three million dollars will provide a capacity of 1,000 tons daily with a net return under the present market of one million dollars annually.

ECONOMICS OF THE FUEL OIL SITUATION

By EUGENE McAULIFFE
President, Union Colliery Company

Within twelve months the fuel oil situation, insofar as present and future supply, as well as unit costs, are concerned, has undergone startling changes. One year ago we were alone concerned with the economical consumption of fuel oil; today there is a national, even international, feeling that the period of fuel oil consumption for steam making purposes is substantially behind us.

After practically effecting the consummation of a very extensive oil burning program the Naval Department asking in March last for Pacific Coast bids on 4,500,000 barrels of fuel oil, received but one bid covering a delivery of but 602,000 barrels, at a price of $1.95 per barrel. In April bids were requested for Atlantic Coast deliveries, five tenders returned, covering an entirely insufficient supply, the price for bunker oil ranging from $2.07 to $3.76 per barrel of 42 gallons. A similar fuel problem confronts the American merchant marine, the completed program of the United States Shipping Board, aggregating 10,000,000 dead weight tons, of which 2,000,000 tons will consist of coal burning vessels and 8,000,000 tons of oil-burning vessels. The estimated fuel oil requirements of the Shipping Board for the year 1920 are forty million barrels, and for 1921 sixty million barrels.

When we consider that the necessity for maintaining a navy will not cease until the end of the existing generally used form of government, or until the millennium arrives, both of which are perhaps quite remote, it would seem very plain that the requirements of the United States Navy, equipped to carry and burn oil will take precedence over any other demand, and it is equally reasonable to assume that after the American people have spent not only millions but billions in the upbuilding of an American merchant marine, that its fuel oil requirements will take position only second to that of our battleships. The statement of men who should know, that 1920 and 1921 will mark the peak period of oil production with a steady decadence from this time forward justifies serious consideration of the oil problem. The United States Geological Survey estimates that with the close of the year 1919 we have taken approximately five billion barrels of oil out of the ground and that the estimated oil reserve yet in the ground is six and one-half billion barrels. Whatever does the future promise?

Between 1909 and 1918 the number of automobiles and trucks increased 1700 per cent, and the consumption of gasoline for automobile purposes jumped from 13,000,000 to 85,000,000 barrels, or 650 per cent, while the production of crude oil increased 95 per cent. Today we operate 7,600,000 automobiles and motor trucks, and 350,000 tractors, and the 1920 construction program totals 2,000,000 automobiles and motor trucks. Power boats, aeroplanes and minor power pumping plants employ thousands of internal combustion engines, all calling for oil and gas. It takes a half pint of oil to translate a ton of coal into power by way of the steam engine, to consume the power so generated takes much more. Without petroleum we could no more grease the bearings and spindles of industry than we could light our great buildings and streets with tallow dips. The total available animal fats, together with that which might be possible to extract from sea life in the period of a year, would not even dimly light and poorly lubricate the world for one-tenth of that time, even though food fats were taken to swell the supply. The government has thrown open for drilling 6,500,000 acres of national oil reserve, but these lands located in California and Wyoming will not add materially to our supply. In 1919 twenty-nine thousand wells were driven, to success or failure; of these 6,000 were dry, 2,000 returned gas without oil, the drilling expense estimated at $600,000,000.

The translation of oil into steam will quickly cease, through the pressure of economic forces and the transportation companies must perforce sense the changes that are taking place in the fuel oil world. Millions of dollars were saved in past years by the substitution of cheap crude oil and refinery residuum for coal in locomotive fireboxes. Only twelve years ago it was difficult to force the skimming plants of Texas and Oklahoma to take sufficient gasoline out of the crude to make its use on a locomotive safe. The railroads who then absorbed the residue left after the taking off of the lighter distillates built up a comfortable refinery traffic for their rails, but a complete return to coal fuel is now imminent. To avoid the necessity for summary and violent changes the work of shifting fuels should be undertaken at once and conducted quietly and gradually. Fifty million barrels of fuel oil represents twelve million tons of coal. This is not a large tonnage if it were not for the fact that the major portion of the oil is consumed where the coal production is relatively small.

Other Papers

The report of the committee on Fuel Stations which was here presented will be abstracted and published in a later issue of the *Railway Mechanical Engineer.*

M. A. Daly, Northern Pacific, chairman of the committee on firing practice, conducted before the association certain simple chemical experiments which are used in the Northern Pacific instruction car to instruct and interest engine crews in the principles of combustion. The discussion showed considerable interest in these methods.

The committee on pulverized fuel reported that efforts to secure reliable comparative cost data during the year were unproductive and the discussion indicated a desire on the part of members for information of this character applicable to decisions on local problems rather than further data of a general character about the process. Such information as was brought out in the discussion indicates that about the only extensive experience in locomotive service has been where low grade, cheap coals, such as anthracite silt, are available.

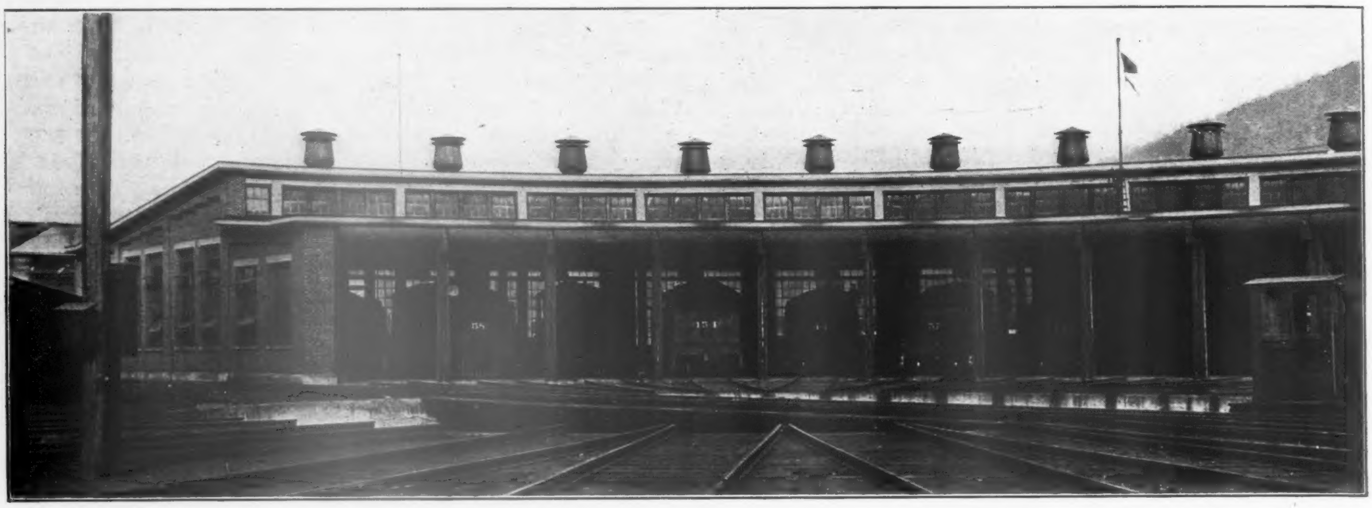
M. B. Morrow, Canmore Coal Company, Canmore, Alberta, addressed the association briefly during the closing session.

Association Business

The secretary-treasurer's report showed a gain of membership of 311 during the year with a total of 1,297. Owing to the increase in the cost of printing amendments to the constitution and by-laws were passed increasing the annual dues from three to four dollars.

The question of affiliation with the American Railroad Association was brought up and action was deferred till the next convention.

The following officers were elected for the ensuing year: President, J. B. Hurley, Wabash; vice-presidents, W. L. Robinson, Baltimore & Ohio, W. J. Bohan, Northern Pacific, and R. Bradley, Boston & Maine; executive committee: P. E. Bast, Delaware & Hudson; J. N. Clark, Southern Pacific; Robert Collett, New York Central; C. C. Higgins, St. Louis-San Francisco; J. M. Nicholson, Santa Fe; A. W. Perley, Oregon-Washington Railroad & Navigation, and T. Duff Smith, Grand Trunk Pacific.



MODERN VS. OBSOLETE ENGINE TERMINALS

Advantages of Modernized vs. Antiquated Engine Terminals Considered from Many Different Angles

BY C. C. LANCE
Shop Engineer, Seaboard Air Line

DURING the past ten years the average size and weight of locomotives has increased from 25 to 30 per cent. In addition the complications brought about by the various specialties required on large modern locomotives, such as Power Reverse Gear, Stokers, Grate Shakers, Coal Pushers, Super-heaters, Headlight Dynamos, Automatic Fire Doors, Duplicate Air Pumps, of large size or cross compound, and the flexible steam and exhaust connections, intercepting valves, duplicate valve gears and other devices brought into use on articulated compounds, have greatly increased running repair and maintenance work. In fact, owing to the large size and weight of important parts and countless number of additional devices to require attention, that were comparatively unknown and unnecessary on small engines, the volume of work has increased in a larger proportion than the size of locomotives.

Increased tonnage and faster movement made possible by modern motive power have necessitated improvements in the physical condition of railroads that have been beneficial to operating and maintenance of way departments. Heavier rail and bridges, longer passing tracks, larger classification yards, reduction in grades and better roadbed have made it easier for the departments mentioned to care for their work although even these improvements have not kept pace with requirements and during Federal control were for the most part discontinued. The same consideration has not been given to the requirements of the mechanical department with the result that many roads are making vain effort to maintain heavy modern power at inadequate and obsolete terminals. Few modern engine terminals have been provided, except on some of the larger and far-sighted roads, and for the most part the terminals now being used to handle Mallet, Santa Fe, Mikado, and Heavy Pacific type engines were built from 20 to 25 years ago, when the largest engine was of the 10-wheel type. This is true of many important points handling from 500 to 900 engines per month. Spasmodic attempts have been made to modernize some of these old facilities by putting in 100-foot turntables and adding extensions to old roundhouses, but the fact remains that large power is still being handled with extreme difficulty in small crowded terminals where there is no possible opportunity to do more than makeshift repairs.

The Cost of Inadequate Engine Terminals

Annual improvement budgets are made up by most roads, giving in detail the needs of every department. The Mechanical Departments always bring up the question of adequate terminals showing the money justification and urging the provision of their minimum needs. For the most part discussion of these matters is closed with the statement that "they got by last year with what they had and ought to be able to run another year." Small consideration is given to the cost of handling power in obsolete terminals and its effect on future life and condition of engines. There are many terminal points that would be abandoned if a cost analysis was made which took into consideration the depreciation of power improperly maintained, the cost in road overtime due to poor work or terminal delays, fuel and labor expended standing engines on in and outbound tracks under steam on account of insufficient house room, ash pit facilities, etc.

At least one hour's time can be saved in the time required to make running repairs to each locomotive handled, considering that the average value of a locomotive in good working order is at least $50 per day, time saving of one hour would mean a gain of $2 per engine handled on account of increasing the total number of hours engines would be available in good working order. In addition to this on account of eliminating practice of mechanics attempting repair work on tracks outside of roundhouse, which naturally due to difficulty in handling materials and distance from tools increases cost of this work, a saving of at least one hour's time of one mechanic at 72c. per hour and one helper at 49 c. per hour or a total of $1.21 per engine will be made. This combined with the $2 time saving will amount to $3.21 saving per engine, and on an average of 50 engines per day the total annual saving will be $58,582.50. To this can be added a loss of $30,000 per annum which represents the actual cost of fuel burnt, and the time of engine watchmen that are required to keep up the fires of engines that are either waiting for vacancy in roundhouse or engines which have been removed from roundhouse in order to make room for others, and are kept under steam for unnecessarily long periods, waiting until they are called to take out trains. This makes a total annual saving of $88,582.50, which would result from

improved engine terminal facilities that would not cost over one million dollars, although the return assured on an investment of that magnitude would be almost nine per cent.

Obsolete Roundhouse Throws Burden on Back Shop

There are cases of old roundhouses having new and large turntables installed where the edge of pit is so close to front of house as to interfere with moving or handling of engines and preventing adjacent tracks being used for large engines on account of insufficient clearance. At some engine terminals the facilities are so inadequate that all trailer wheels removed, driving wheels dropped and similar work must be done in back shop under crane, taking up valuable engine pits and interfering with classified repairs. This, of course, can only occur at division shop points but would never occur at all if proper consideration to improvement needs had been given.

Generally roundhouses are low, smoky and in the South they are not provided with adequate heating facilities on account of the so-called short mild winters. In spite of the short mild winters referred to a surprising number of stoves are required and many instances of frozen piping and frozen up engines occur during at least five months of the year. The money wasted in fuel and attendance to stoves, thawing pipes and engines and highly paid mechanics loafing around stoves would in most cases pay for the installation of extensive heating systems and show a saving.

Some of the Improvements That Are Needed

The life of firebox, stay-bolts and boilers can always be prolonged by washing with hot water. Washing with cold water which must be done in order to get engines back into service promptly at points having no boiler washing plant is very injurious and causes leaky tubes, broken stay-bolts, cracks and other defects. There is a surprising lack of facilities for washing and filling boilers although it has been definitely proven that fuel is saved through filling boilers with hot water near the boiling point and by having clean sheets and tubes. The actual fuel saving due to filling boilers with hot water will amount to at least one-half to three-quarters of a ton of coal per engine handled, which would alone justify the expenditure, not considering the fuel savings made on account of clean tubes and sheets or the decrease in boiler repairs required and the saving in time required for washing boilers.

The machinery equipment at many roundhouse points has long been accumulated through the simple expedient of sending worn out and obsolete machinery no longer useful in main or division repair shops. This is a serious and expensive mistake and machinery of this character should be scrapped or otherwise disposed of. The roundhouse machine work must be done without delay, as in many cases there are no extra parts on hand and any manufacturing or fitting must be done accurately and promptly which cannot be done on worn out or broken down tools. Only the most modern machine tools should be installed and the small hand tools should be of good quality and furnished in such quantities as to avoid delay when more than one mechanic is required to do similar work. In old roundhouses handling heavy power delay and difficulty is usually experienced handling rods, cylinder heads, cross-heads, steam chests and other heavy parts by hand. Jib cranes have been put in for handling front cylinder heads and steam shafts, but overhead crane service should be provided in both roundhouses and shop to reduce the labor costs to a minimum.

Coaling and Ash Handling Facilities Require Particular Attention

The size, type and location of coaling and ash handling facilities contributes greatly to the successful operation of engine terminals. Many ash pits are the old style depressed track type that require deep pits and tracks supported on columns. These are hard to maintain and require large labor forces to handle cinders. In crowded yards this type of pit takes up much valuable room, on account of the approach to the depressed cinder loading tracks. Any type of cinder pit installed should provide for prompt mechanical removal of cinders and elimination of expensive hand labor, and delay to engines, pits having overhead crane service or bucket conveyors being preferable. Low first cost has generally been the consideration when erecting coal chutes and results in annoying and expensive delays when repairs are necessary account of poor design or light construction. Coal chutes should be provided with powerful rugged hoisting mechanism whether operated by steam or electricity, serving more than one track to eliminate all possible delay. Sand drying and delivering facilities should be arranged so coal and sand can be taken at the same time. There should be several water cranes located at the most convenient points.

A Comprehensive Plan Essential

I have endeavored to call attention to a few of the main features that will have to be remedied before efficient and economical operation can take place and power kept at its maximum efficiency. The longer the provision of adequate facilities is delayed, the greater will have to be the final expenditure. A comprehensive improvement program covering the requirements for the future as well as present needs should be mapped out by every railway and followed through to a conclusion. Care should be taken not to locate terminals where there is insufficient room for extension, thereby making it necessary to move to new location when extensions are required. Many improvements have been made in the past of light or semi-permanent construction—with an eye to economy in first cost. This is a serious error in judgment for buildings of this character soon deteriorate, are expensive to maintain, and in wet or cold weather work is interferred with and machinery and equipment damaged.

The most economical plan when providing facilities, taking into consideration all features, is to provide well planned and constructed facilities properly located, just a little larger than needed to care for immediate requirements, equipped with the best machinery and most up-to-date equipment obtainable. The execution of this plan will result in an actual money saving, a decrease in engine failures and terminal delays, prolonged life and increased efficiency of motive power.

FEDERATED AMERICAN ENGINEERING SOCIETIES

A total of 134 delegates, representing 66 engineering and other technical organizations, responded to the invitation of the Joint Conference Committee of the four founder societies to meet in Washington, D. C., on June 3 and 4. The result of this convention was the formation of The Federated American Engineering Societies, composed of societies and affiliations and not of individuals. The first action after the election of the chairman and secretary was the presentation of the following resolutions:

Resolved, that it is the sense of this convention that an organization be created to further the public welfare wherever technical knowledge and engineering experience are involved, and to consider and act upon matters of common concern to the engineering and allied technical professions.

Resolved, that it is the sense of this convention that the proposed organization should be an organization of societies and affiliations and not of individuals.

The discussion which followed concentrated upon these resolutions. This brought forth a variety of opinions. The representatives of the American Association of Engineers, evidently believing that the new organization would possibly interfere with, or in some ways duplicate, their efforts in public welfare work, carefully sounded out the assembly on

the question of a society composed of individuals. Outside of the attention given the matter by this society the question of an organization composed of individuals received but little attention, the chief objection to it being the difficulty attending its promotion. The fact was brought out that practically all of the active members of the local and national societies were members of two or more organizations and that as such was the case there would be great difficulty in securing a membership large enough to promote and carry on the desired work.

With the sentiment in favor of an organization composed of societies and affiliations, the American Association of Engineers yielded its point and, joining with the rest, made the vote in favor of adopting the resolutions unanimous.

Constitution Is Adopted

The constitution, as presented at the second day's session, was finally adopted with a few minor changes and one addition, a publicity clause insuring the maximum co-operation with the press. In brief, the constitution provides for an organization to be composed of national, local, state and regional engineering and allied technical organizations. The management will be vested in a body known as the American Engineering Council and an executive board composed of 30 members of the council, including the president, the four vice-presidents and the treasurer of the council. Representation on the council will be on a basis of one member for the first 100 to 1,000 members of a society and one for every additional 1,000 or major portion thereof up to a maximum of 20. While it is in some measure true that this plan would give the nationals too large a relative representation it was shown that the affairs of the nationals and the locals were so closely allied and the memberships of the two were so closely interwoven that in reality it would make but slight difference. Members of the executive board will be elected by districts, the proportion being the same as on the council.

Funds for the financing of the new organization will be provided by contributions from each member-society equal to $1.50 per member for the national and $1 per person for the local, state and regional organizations. Several local societies objected to this on the basis that a large part of their membership consisted of non-voting members paying small dues and that the tax would be out of proportion.

Under the circumstances the constitution was interpreted to read that as each organization must submit its constitution and by-laws to the executive board before becoming a member, it could at that time submit a statement showing the number of voting members or members upon which it wished its representation based. The board would then be in a position to judge fairly and to decide in each case what would be equitable.

Provision was made for co-operation with and the encouraging of local, state and regional organizations in the formation of affiliations for the purpose of considering public welfare matters. In inserting a publicity clause, a provision was made for the formation of a publicity committee and in order to further their work all meetings, except executive sessions of the board, were to be open meetings, and the books and minutes of the organization were to be open for transcription at any time.

The constitution and by-laws were adopted by the conference by a unanimous vote of all voting, although several societies refrained from casting a vote, even though it was understood by all present that any decision made by a delegate was not binding upon his society. The largest organization not voting was the American Association of Engineers, whose representatives refrained from voting on the basis that as they disagreed with certain sections of the constitution they did not feel at liberty to ratify it. They did wish, however, to assure the conference of their sincere intention to co-operate to the best of their ability and along such lines as the Federated American Engineering Societies would formulate, leaving the question of ratification to a vote of the association itself.

The only delegation present with full power to accept or refuse any action of the conference was that of the American Society of Mechanical Engineers, who ratified the constitution in the name of that society. The representatives of this society further stated that the society was ready to enter the federated societies at any or such time as the latter found convenient to handle such work.

Significance of the Federation

A study of the constitution adopted reveals the underlying significance of the federation and outlines in some measure the scope of its future activities. The following statement from Article II of this document is worthy of note:

Service to others is the expression of the highest motive to which men can respond, and duty to contribute to the public welfare demands the best efforts that men can put forth; therefore, it shall be the object of this organization to further the interests of the public through the use of technical knowledge and engineering experience, and to consider and act upon matters common to the engineering and allied technical professions.

In this paragraph is revealed a splendid appreciation of responsibilities of the engineering profession to the public welfare. The engineering profession today exercises a greater control over those forces of nature that affect our material welfare than any other profession; although the youngest, it has acquired in a brief space of time the greatest potentialities for doing good. The organization of this federation is, in fact, a belated appreciation of the dignity and power of the profession as a whole, and a desire to put into concrete form an expression of the ideals of the engineer.

In this movement the engineer both sacrifices and gains something affecting his personal interests. Affiliation with the federation represents a subordination of the purely personal objectives to the public good, but at the same time the engineer has gained much. The federation should go a long way towards dignifying the profession and towards commanding the respect of all other interests. It should tend to put the engineering profession in its proper plane and to put the individual engineer in a position where he cannot be exploited.

Federation and the Railroads

The formation of this important federation should mean something to men of the engineering profession in railroad service. While a few engineers have made a brilliant success out of a railroad career, the profession has not as a whole fared favorably at the hands of the railroads, and this in turn has reacted unfavorably on the railroads themselves, until we have a situation in which but relatively few young engineers are engaging in railroad employ.

Railroad work should afford a splendid opportunity for the engineer, its technical problems are immense and it has been demonstrated that the trained engineer often makes a most proficient executive in the operating as well as the technical field. It is not too much to say that the engineering profession affords the best if not the only salvation for the railroads in their endeavor to perform a great public service with insufficient and inefficient equipment. The Federated American Engineering Societies can do much towards improving the standards of remuneration for engineers and towards creating appreciation of the value of engineering service; it can also point out the engineer's responsibility to the public and public service in which the railroads must figure prominently.

CAR DEPARTMENT

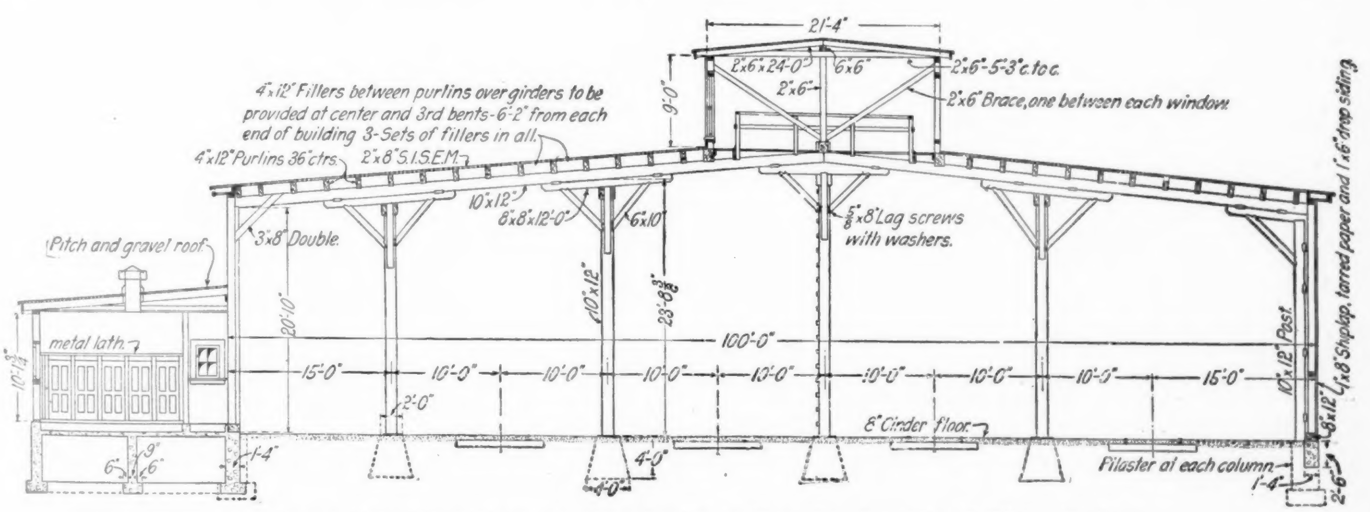
TWO ADDITIONAL STATES REQUIRE CAR REPAIR SHEDS

Recent statutes passed by the states of Minnesota and North Dakota require railroads or other concerns doing car repairing to provide suitable houses so that the men engaged in this work are protected from the weather. The Minnesota law requires that such buildings shall be constructed wherever there are six men engaged at one time in the repairing of cars, car trucks, etc., while in North Dakota the minimum is five men. Exception is made in the case of repairs to cars while they are en route as part of a train.

The Minnesota law goes into minute detail as to the character of the building and leaves very little of the design to be determined by the railway company's architects or engineers. The specifications as given in the statute are as follows:

"In buildings that cover more than one track the distance between the inside rails of each track shall not be less than 12 ft. Between the walls of the building and the outside rails there shall be a distance of 10 ft. The building or buildings shall not be less than 20 ft. high at the eaves. Each building shall be enclosed from roof to ground and shall have glass windows on each side not to exceed 12 ft. apart. The side windows shall not be less than 9 ft. high and not less than 4 ft. wide. Windows shall be in three sections and each section shall be equipped with pivot and opening device. The buildings shall be equipped with side and end doors. The end doors shall be not less than 6 ft. wide and 15 ft. high, and there shall be two such doors for each track covered by the building. The side doors shall be the same width and height as the end doors and shall be not to exceed 40 ft. apart. The roof shall be provided with a cupola the entire length of the building and be equipped with side windows of not less than 3 ft. in width and 6 ft. in height, having pivot and opening device that shall be at all times operative. A similar cupola shall be provided for each two additional tracks in width of such building.

"The buildings shall be equipped with necessary heating facilities and shall at all times have drainage that will keep them in a clean and sanitary condition. They shall be equipped with sanitary drinking fountains where clean, wholesome drinking water can be obtained. A sufficient number of sanitary lavatories shall be provided for said employees. Such toilets shall be properly partitioned and there shall be at least one for each 15 persons employed. All scaffolding used in such buildings shall be made of clear lumber free of all knots and shall be kept in first-class



Car Repair Shed Designed by Northern Pacific to Meet Requirements of Minnesota Law

condition at all times. The use of paint spraying machines shall not be permitted inside such buildings."

The execution of the law is imposed on the Railroad & Warehouse Commission of Minnesota, which shall determine as soon as practical where and what buildings are to be built by the railroads and issue orders accordingly. Penalty for failure to comply with the provisions of the statute is a fine of not less than $100 or more than $500 for each offense, and each day or part of the day that failure continues constitutes a separate offense.

The manner in which railroads are complying with these statutes is indicated by the drawing of a structure designed by the Northern Pacific for construction at Watertown, N. D. This is a frame shed, 100 ft. by 250 ft., supported by 10-in. by 12-in. posts and spaced 20 ft. center to center transversely, and 21 ft. longitudinally. The roof consists of 2-in. by 8-in. planks carried on 4-in. by 12-in. purlines and covered with pitch and gravel roofing. The walls are composed of a layer of 1-in. by 8-in. shiplap covered by 1-in. by 6-in. drop-siding with tarred paper between. The foundations are of concrete and the floor of cinders. Tracks are provided at 20-ft. centers. The monitor is 21 ft. wide by 9 ft. high and is equipped with corrugated iron curtain walls at intervals of about 62 ft. as barriers to spreading fires. Toilet facilities are provided in a lean-to 18 ft. by 22 ft. in the middle of one side.

AIR PRESSES DESIGNED FOR CAR SHOP AND RECLAMATION WORK

BY F. S. TINDER
Material Inspector, Virginian Railway

Two air presses built for the reclamation department and car smith shop of the Virginian Railway have proved of considerable value in facilitating both reclamation and repair work, and their use has resulted in important savings of material and money. The double action press illustrated in Fig. 1 was developed for use in the reclamation department and has been kept busy straightening bent shanks and resetting guard arms of car couplers, straightening angle and channel iron, flanged sheets for pressed steel cars, and other

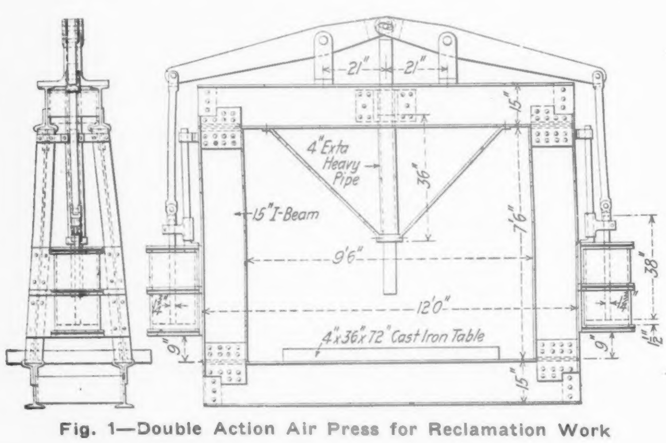


Fig. 1—Double Action Air Press for Reclamation Work

miscellaneous work. It is also used to great advantage in straightening and reflanging pressed steel car parts, as this material is best straightened cold. By the use of suitable dies on this machine, such miscellaneous articles as truss rods for brake beams, corner angles, sill steps, etc., can be formed and bent.

The machine is built mostly of second-hand material, the 15-in. I-beams used for the frame being removed from old bridges. Second-hand 14-in. by 12-in. air brake cylinders were used, two of these cylinders being bolted together and rebored for each side of the press. As indicated in the illustration, a guide and crosshead is provided for the piston and through the operation of suitable levers, the plunger is forced down against a cast iron table on which the work is placed. The entire framework of the press is substantial and rigidly connected. The plunger is held in a vertical position by a supporting guide made of 4-in. heavy pipe, rigidly held in place. It is possible to obtain a working pressure of approximately 50 tons with this press.

The air press developed for blacksmith shop use, shown in Fig. 2, is built of the same material as the double action press previously described. The construction and operation of this press is quite plainly indicated in the sketch and will develop practically one-half the pressure of the double ac-

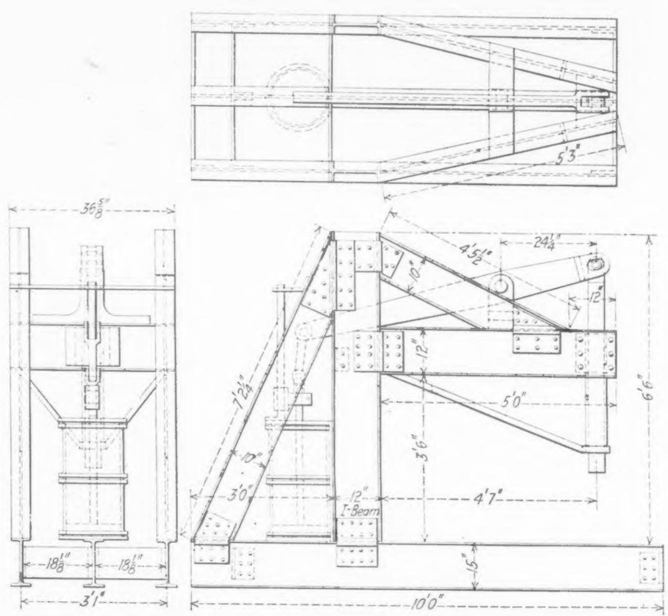


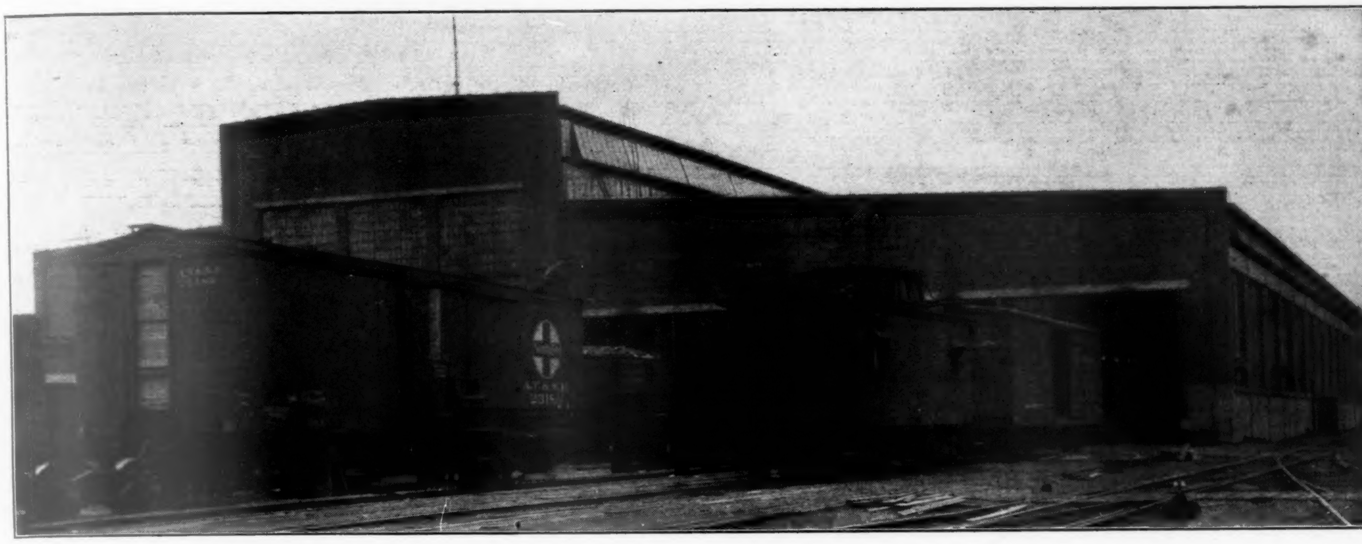
Fig. 2—Single Action Air Press for Car Shop Work

tion press. An additional advantage, however, consists in the fact that one side is open. This makes it possible to handle large sheets and odd shaped material. The press is used for straightening and forming various car parts.

The valve operating both of these air presses consists of an operating seat and stem used with the top case of an H-6 Westinghouse brake valve, the two important positions of the handle being application and release. The ordinary designs of air presses with a large cylinder acting directly on the ram are not only wasteful of air but also make it difficult to use sledges for straightening sheets while held in the press. These presses are economical in operation, easy to make and will be found important adjuncts to facilitate work in both the reclamation department and car blacksmith shops.

HOW AN ENGINEER GOT RICH.—We have just learned of an engineer who started poor 20 years ago and has retired with the comfortable fortune of $50,000. This money was acquired through industry, economy, conscientious efforts to give full value, indomitable perseverance and the death of an uncle who left the engineer $49,999.50.—*Official Bulletin, Colorado Society of Engineers.*

HEAT TREATMENT OILS.—The essential requirements of tempering oils are: flash and fire tests high enough to avoid serious evaporation loss or to incur high fire risk, comparative freedom from decomposition, absence of acid or acid forming substances, which would have a materially corrosive action on metals at high temperature, a fairly high heat capacity, and enough fluidity to permit rapid carrying-away of the heat.—*The Atlantic Lubricator.*



The Freight Car Shop at Elizabethport

Car Repairs at Elizabethport Shops

Interesting Features of the Work Done at the Principal Plant on the Central Railroad of New Jersey

THE Elizabethport shops of the Central Railroad of New Jersey are the largest car shops of that road, having a capacity of about 4,000 cars a month. The great variety of work done at this plant involves some interesting and novel practices. The account which follows is intended not as a comprehensive description of the shop practices, but rather as a few notes on methods used for facilitating the work, for eliminating maintenance troubles and for securing improved service from the equipment.

Bracing Applied to Corners of Box Cars

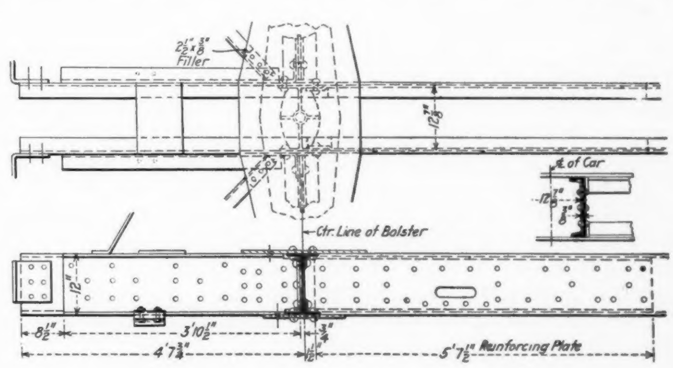
Reinforcing Wooden Cars

In cars with wooden superstructure it has been found that the weaving of the body loosens the sheathing and lining and causes the car to leak. This action is particularly noticeable near the ends, and to overcome it the corners of cars passing through the shops are being strengthened by the application of diagonal braces. These braces, as shown in the illustration, are made of 4-in. by 1-in. channels, or of 3-in. by 3/8-in. bars, with an angle of 1/4-in. plate riveted to each end. One brace is used in each of the four corners, being bolted to the side plate and the end plate.

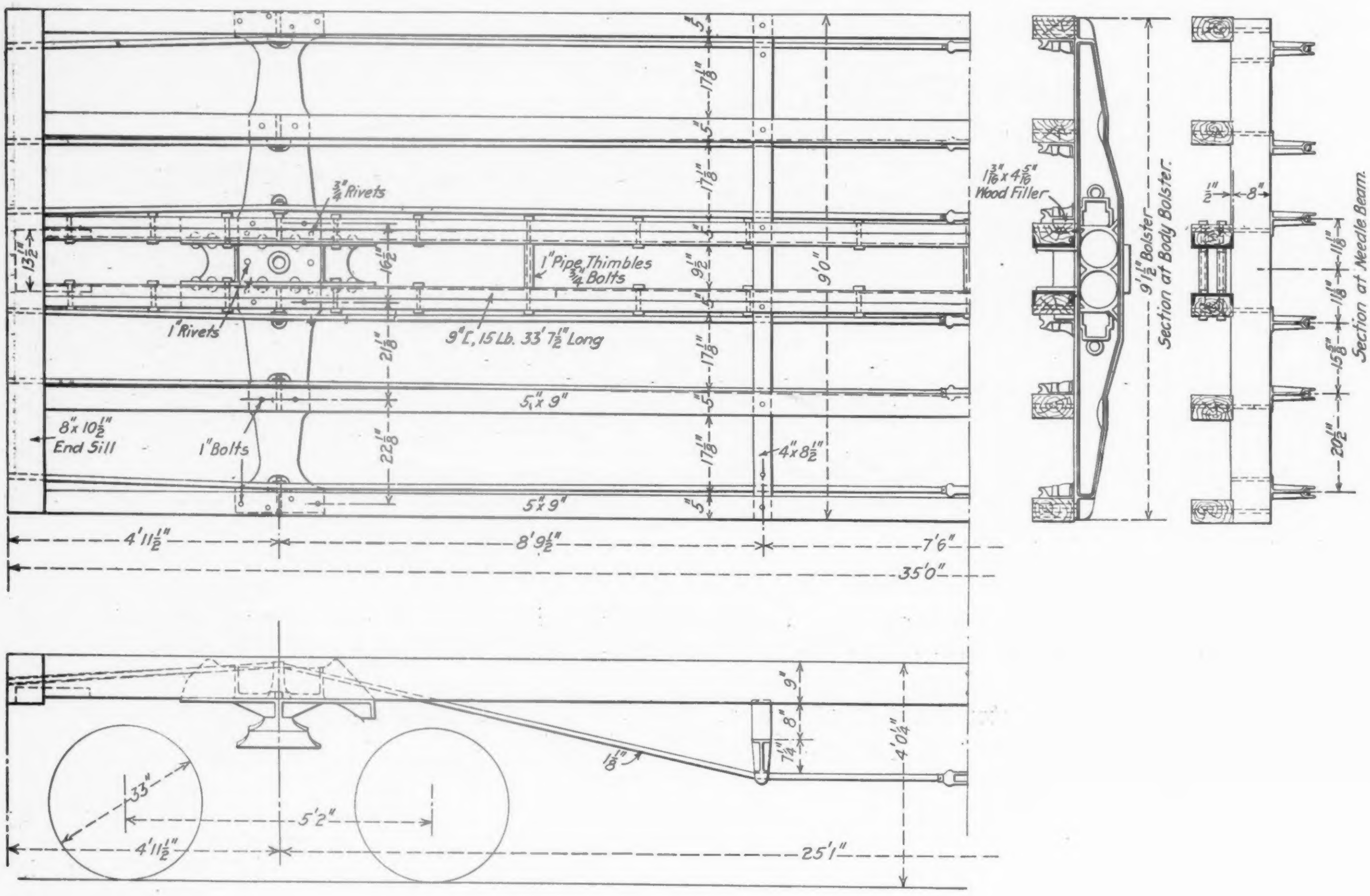
On some of the wooden box cars of 60,000 lb. capacity steel center sills are being applied in connection with transom draft gear and friction springs. The center sill reinforcing consists of 9-in., 15-lb. channels, spaced 9½-in. back to back, with the flanges extending over the wooden center sills, to which the channels are bolted every two feet. Stop plates are riveted between the channels and to these in turn are fastened the bolsters. In order to give additional strength to the section of the center sill between the bolsters the two sills are tied together with ¾-in. bolts and 1-in. pipe thimbles. The end sill is reinforced by a 10-in. channel.

Reinforcing Center Sills on Coal Cars

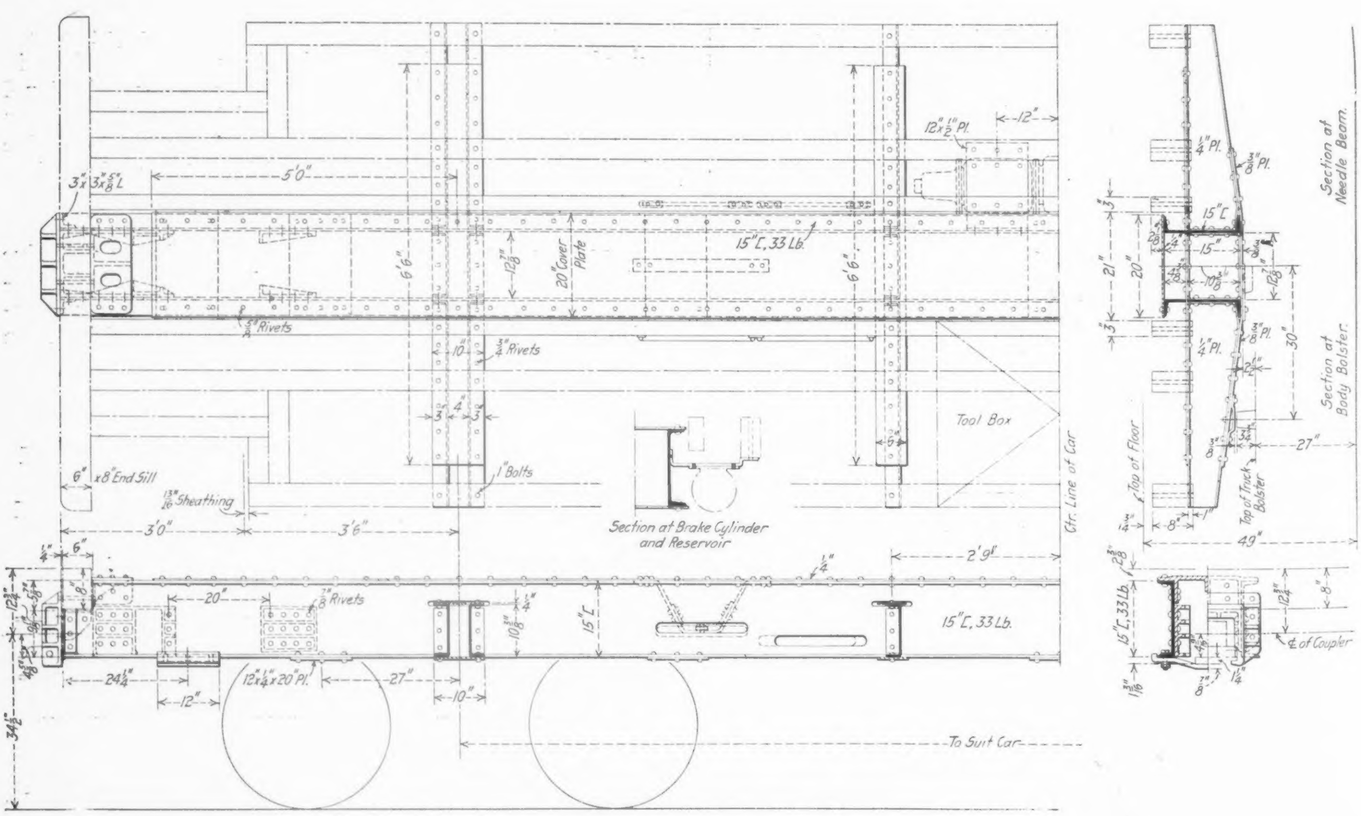
Hopper cars used for coal traffic often give trouble due to the center sills buckling a short distance beyond the bolster. The cause of such failures is usually excessive corrosion of the sills resulting from the moisture that drips upon them at this point. It is difficult to protect the sills from the water, which often contains sulphuric acid from the coal. Failure of the center sill is very costly to repair and to avoid such trouble the underframes on some classes of hopper cars have been reinforced at the points where they pass through



Reinforcing for Hopper Car Center Sills



Reinforcing for 60,000-lb. Capacity Box Cars

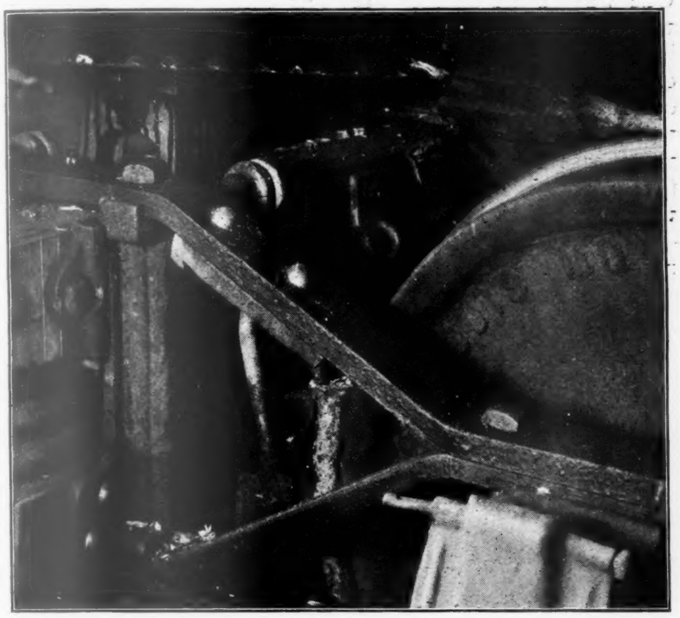


Steel Underframe Applied to Caboose Cars

the hopper. This reinforcing consists of 3/8-in. plates, 5 ft. 7 1/2 in. long, flanged to fit between the flanges of the center sill channels as shown in the drawing.

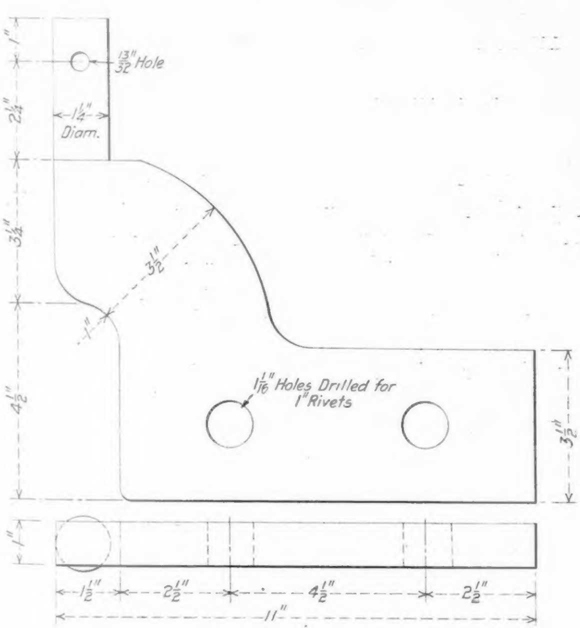
Steel Underframes for Cabooses

In order to make wooden cabooses suitable for modern service, the Central Railroad of New Jersey is fitting this



Bracket for Inside Hung Brake Beams Riveted to Arch Bar

class of equipment with steel underframes which are constructed at Elizabethport shop. The details of the underframes have been standardized. The center sills are made up of two 15-in., 35-lb. channels, continuous from end to



Details of the Brake Hanger Bracket

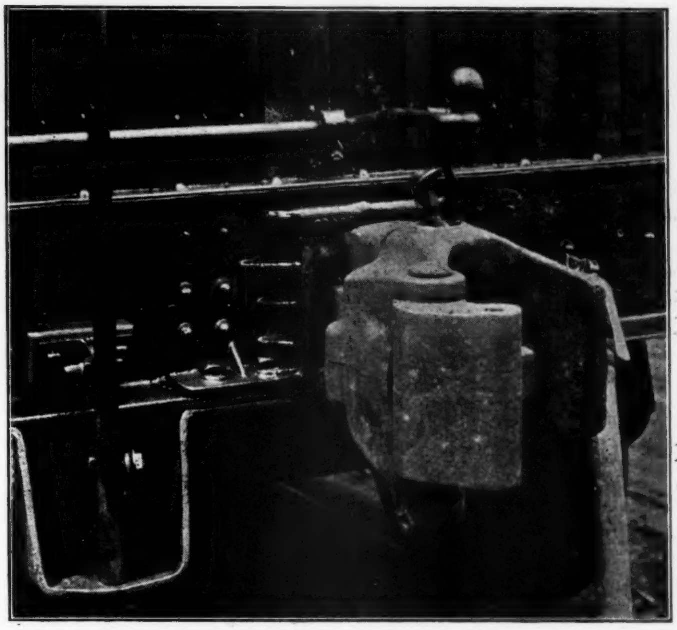
end. The center line of draft is 4 5/8-in. from the lower flanges and the upper flanges and web plates are notched to receive the 6-in. by 8-in. end sill, which fits between the striking plate and a filler casting. A cover plate 1/4-in. thick and 20 in. wide extends 5 ft. beyond the bolsters.

The body bolsters are of channel section, pressed from 1/4 in. steel plate. Pressed steel fillers are also used between the center sills at the bolsters. The web plates are spaced four inches apart and fit against the lower flange of the center sill. The top cover plate 10-in. wide, 1/4-in. thick and 6-ft. 6-in. long, passes through slots cut in the sills. The bottom cover plate is 3/8-in. by 10-in. by 6-ft. 6-in. and extends under the body bolster. Cast steel center plates and pressed side bearings are used.

The needle beams have web plates of one pressed section identical with those used in the bolsters. The fillers between the channels are also the same. The top cover plates are 1/4-in. by 6-in. by 6-ft. 6-in., while the bottom plates are 3/8-in. by 6-in. by 4ft. 0-in. Cross braces are riveted to the bottom flange of the center sills at the center line of the car midway between the needle beams and bolster and 2-ft. 3-in. outside the bolster. These underframes are fitted to receive Miner A-18 friction draft gear.

A Simple Uncoupling Arrangement

The Central Railroad of New Jersey is now applying to a large number of cars a simple uncoupling arrangement of rugged design, which does away with chains and clevises. The end of the uncoupling lever is bent to form an elon-



Uncoupling Mechanism in Lock Set Position

gated eye. The link for attachment to the coupler lock is a simple piece made in the forging machine from 5/8-in. round stock. A half round head is formed on one end and the eye on the other end is bent partly shut. This eye is slipped through the opening in the uncoupling lever and is closed after the end is passed through the eye in the coupler lock. The freedom of action secured by this arrangement is clearly shown in the drawing.

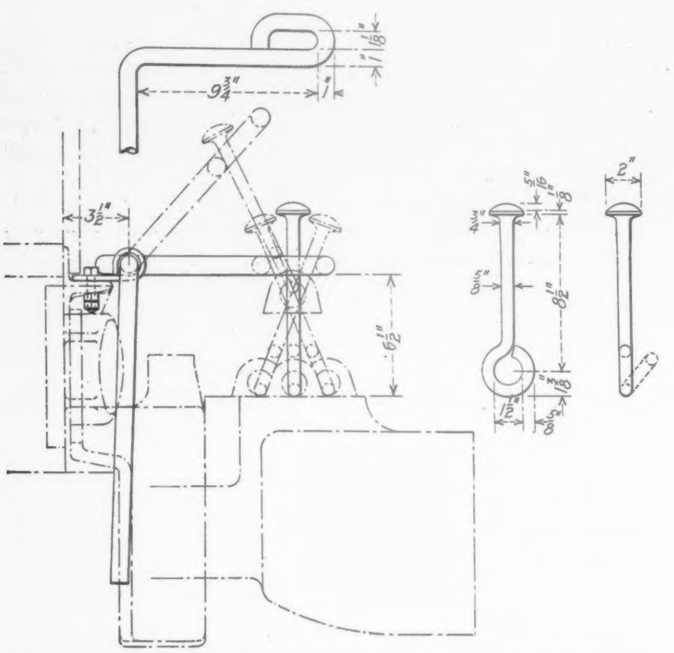
Applying Inside Hung Brake Beams on Caboose Car Trucks

On some of the lighter arch bar trucks which do not warrant extensive remodeling, a simple method has been adopted for applying inside hung brake beams. A forged bracket to support the brake beam is riveted to the top arch bar, as shown in the photograph. This does away with the necessity for changing the column posts or even removing the column bolts. As the arch bar is in compression the rivet holes are not objectionable and the bracket gives additional strength.

Cleaning Passenger Trucks

The labor involved in cleaning passenger trucks has been greatly reduced by using a spray for removing the lye clean-

ing solution. Water alone would not give satisfactory results in washing off the compound. A combining nozzle was made in which the water is introduced into a jet of air, forming a heavy spray. This has sufficient force to clean

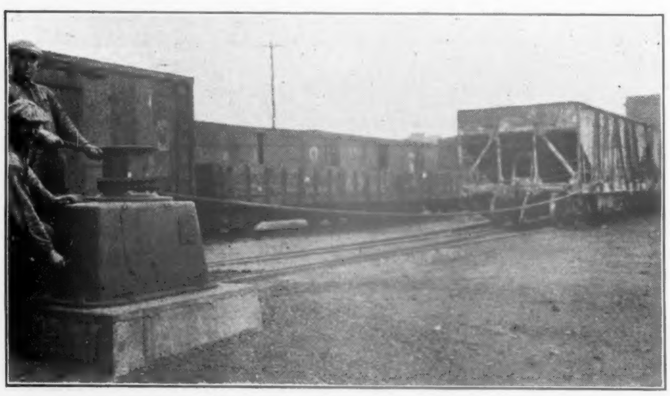


Details of Uncoupling Arrangement Showing Wide Range of Action

the lye from the parts. It is also used for washing down the sides of cars and by attaching it to a tank it can be employed for whitewashing.

Winch for Hauling Cars

Steel cars passing through Elizabethport shop and in need of general repainting are thoroughly sand blasted before the paint is applied. As the sand blast building is only 90 ft.



Hauling a Cut of Cars with the Electric Winch

long the cars must be pulled out at frequent intervals. To avoid tying up a switch engine for this work an electrically operated three-ton Sprague winch has been installed just outside the building. A block is also attached at the entrance to the paint shop and by means of a rope the cars can be hauled in either direction.

THERE IS JUST ONE WAY to force prices down under present conditions—that is for all of us to pitch in and produce so much of everything that at the same time prices can and must go down. Cut the cost and boost the supply and prices must drop. But as long as we go on cutting the supply and boosting the cost by loafing on our jobs, prices will hold their upward course.—*Saturday Evening Post.*

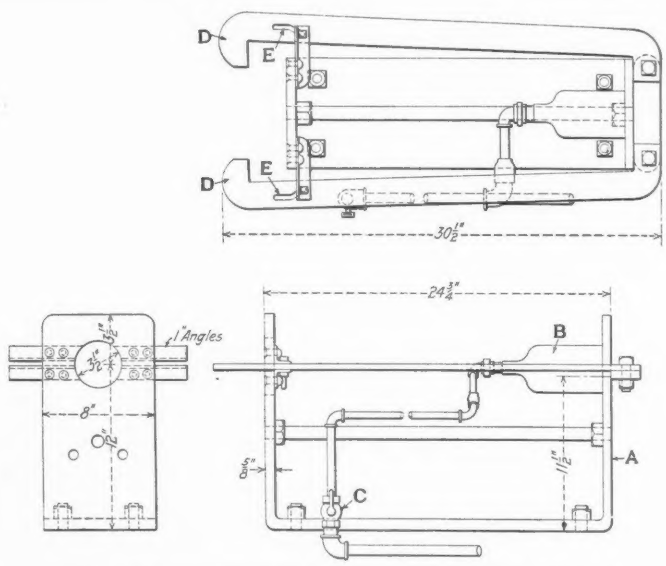
PNEUMATIC CLAMP FOR TRIPLE VALVES

BY T. H. BIRCH

Air Brake Foreman, Chicago, Milwaukee & St. Paul

Many triple valves come to the car shop for repairs and if only a few minutes can be saved on each valve the total saving of time in the course of a year will be considerable. One way in which this time has been saved at the Milwaukee shops of the Chicago, Milwaukee & St. Paul has been by the construction and installation of a device which clamps triple valves quickly and holds them during the operation of cleaning and repairing. Formerly an ordinary vise was used for this purpose, but the contour of the check valve case made it somewhat difficult to hold the valve firmly, and in addition the valve was not in the most convenient position for repair work.

Adapting the clamping principle of the triple valve test rack the device, illustrated, was made and proved very successful for this work. Referring to the illustration, the de-



Clamp for Holding Triple Valves While Being Repaired

vice which is of simple construction consists of a bracket *A* made of ⅝-in. iron, bent up at the end and bolted to the repair bench as shown. This bracket is stiffened by two rods and supports a K-1 slack adjuster cylinder *B,* as shown. This cylinder is operated by air through the operating valve *C,* and when the air is turned on clamping arms *DD* are moved in such a way as to hold the triple valve firmly against the bracket. When the cylinder piston starts to move the clamping arms approach the bracket and come together, being guided by the slots *EE.* The operation of the clamp will be evident from an inspection of the illustration.

For any car shop repairing a considerable number of valves, this triple valve clamp will more than pay for the cost of its construction by the saving in time effected by means of its use.

METRIC SYSTEM CONDEMNED.—In addition to the recent order of Secretary of War Baker directing the discontinuance of the use of the metric system, the Navy Department also, through prominent officers, has expressed its opposition to that system.

REFRIGERATOR CARS.—There are approximately 115,000 freight refrigerator cars and 1,650 express refrigerator cars in service at the present time. Thirty thousand of the freight cars are owned by private car lines, while 250 of the express refrigerator cars are owned by the American Railway Express.

THE INSPECTION OF FREIGHT EQUIPMENT*

Handling and Testing Tank Cars; Regulations Governing Interchange; Billing for Foreign Repairs

BY L. K. SILLCOX

Assistant General Superintendent Motive Power, Chicago, Milwaukee & St. Paul

THE rules of the American Railroad Association, Mechanical Section, cover Standard Specifications for Tank Cars and schedules for testing tanks and tank safety valves. Extracts from sections of the rules relating to the handling of this equipment are given below.

Transportation requirements. (c) A tank which does not meet the prescribed tests shall be withdrawn from transportation service.

Tests

22. *Certification of Tests*: Tests of all tanks and their safety valves shall be certified by the party making the tests to the owner of the tank car and to the Chief Inspector, Bureau of Explosives, in the form prescribed by the bureau.

23. *Tests of Tanks*, CLASS I. Tanks shall be tested at intervals of not over five years.

CLASSES II AND III. Tanks shall be tested before being put into service, again at the expiration of ten years, and after that at intervals of not over five years; with the exception that where tanks are used for the transportation of such corrosive products that deterioration is to be expected in a shorter time, the first test for such tanks shall be reduced to five years. Tanks requiring this five year test shall be those used for the transportation of chemicals such as acids, ammonia, liquors, etc., and such other products as may hereafter be specified.

CLASS IV. Tanks shall be tested before being put into service, and after that at intervals of not over five years.

CLASS V. Tanks shall be tested before being put into service, and after that at intervals of not over two years.

CLASSES I. II, III AND IV. Any tank damaged to the extent of requiring patching or renewal of one or more sheets, or extensive reriveting or recalking of seams, shall be retested before being returned to service.

CLASS V. Any tank damaged to the extent of requiring patching or renewal of one or more sheets shall be retested before being returned to service.

Tanks shall be tested to the following pressures:

Class I	Either 40 or 60 lb. per sq. in.
Class II	Either 40 or 60 lb. per sq. in.
Class III	60 lb. per sq. in.
Class IV	75 lb. per sq. in.
Class V	300 lb. per sq. in.

CLASSES I, II, III and IV. All tests shall be made by completely filling the tank with water, or other approved liquid safe to use, of a temperature which shall not exceed 70 deg. F. during the tests, and apply the pressure in any suitable manner. The tank shall hold the prescribed pressure for not less than ten minutes without leak or evidence of distress after the tank has been calked tight.

CLASS V. The tank shall hold the prescribed pressure for not less than 30 minutes without any leak whatever. Calking to stop leaks developed during the test will not be permitted.

ALL CLASSES. When tanks are tested, the date, pressure to which tested, place where test was made, and by whom, shall be stencilled on the tank in accordance with the Master Car Builders' standard marking for freight cars.

24. *Test of Safety Valves.* CLASSES I, II, III and IV. Safety valves shall be tested at intervals of not over two years, those on new cars being tested before the cars are placed in service.

CLASS IV. At intervals of not over six months.

CLASSES I, II, III and IV. The test may be made without the removal of the valve from the car, provided the valve unseats at a total pressure corresponding with the area of the seat multiplied by the required pressure.

ALL CLASSES. When valves are tested, the date, pressure to which tested, place where test was made, and by whom, shall be stencilled on the tank in accordance with Master Car Builders' standard marking for freight cars.

20. The pressure to which valves shall be set are prescribed in Section 20 of each specification and are:

CLASSES I and II. Products with flash point below 20 deg. F., valves shall be set at 25 lb. per sq. in. Products

*Seventh of a series of articles on this subject by Mr. Sillcox, copyright 1920 by the Simmonds-Boardman Publishing Co.

with flash point 20 deg. to 150 deg. F., valves may be set to 12 lb. per sq. in.

CLASS III. Valves shall be set at 25 lb.

CLASS IV. Valves shall be set at 25 lb.

CLASS V. Valves shall be set at 200 lb.

The tolerance above or below the specified pressure is one pound for the 12-lb. setting; three pounds for the 25-lb. setting and five pounds for the 200-lb setting.

Apparatus for setting safety valves in place on cars should be furnished at the principal repair points. These devices should be made up in accordance with the specification for tank cars, a copy of which must be in the hands of each car foreman.

Interstate Commerce Commission Tank Car Regulations

1822, (g) Tests of all tank cars and their safety valves, as made in compliance with Master Car Builders' rules, must be certified by the party making the tests to the owner of the tank car and to the chief inspector, Bureau of Explosives; and this certification must show the initials and number of the tank car, the service for which it is suitable, the date of test, place of test and by whom made.

1824, (j) After May 1, 1915, a tank car must not be used for shipping inflammable liquids with flash point lower than 20 deg. F., unless it has been tested with cold water of 60 lb. per sq. in. pressure and stencilled as required by Master Car Builders' rules.

Note. For casinghead gasoline, blended or unblended with other products, and with vapor tension not exceeding 10 lb., tank cars, 60 lb. test class, must have safety valves set to operate at 25 lb. per sq. in., and provided with "fool proof" dome covers (see amended paragraph 1824 (k), effective May 15, 1916).

For all other liquids with flash points lower than 20 deg. F., safety valves must be set to operate at 25 lb. and "fool proof" dome covers must be provided not later than July 1, 1917 (see amended paragraph 1825 (k), effective July 1, 1917).

The above instructions are taken from the Standard Specification for tank cars. It is important that each car foreman familiarize himself with the specification for tank cars, and especially the instructions pertaining to the testing of tanks and the safety valves. As stated above, certain points should be equipped with the apparatus for testing valves on cars, the object being to equip only the more important interchange points, so that cars can be tested before being delivered in interchange, when the date of the last test requires that retest be made. All points having equipment to test safety valves should make the report on B. E. form 17-B, Certification of Test, to cover each car tested.

Leaky Tank Cars.—In cases where tank cars are transferred due to leakage and no repairs made, they should be stencilled on each side "Leaky tank; do not load until repaired."

Outlet Valves and Dome Caps on Tank Cars

Tank cars enroute should never be allowed to proceed with tank outlet valve caps dangling from retaining chains, since they break off and are lost in this manner. In some instances, employees have been found opening outlet valves on the bottom of empty tank cars which have been loaded with gasoline or other oils, to drain them. This is a very dangerous practice and should not be permitted. In the same manner dome caps are to be properly secured and in place at all times.

Hooks for Refrigerator Car Doors

Refrigerator cars not equipped with door hooks and fasteners to secure the doors in an open position will not be accepted in interchange.

Stake Pockets for Flat Cars

It is desirable and necessary for flat cars used in commercial service to have side stake pockets spaced 24 in. minimum and 42 in. maximum. System cars are to be equipped as fast as possible with bent plate type stake pockets secured by either bolts or rivets and inside washer bearing plate.

Temporary Running Boards

When it is necessary to provide temporary running boards and hand rails to well-hole cars and those not equipped with roofs or running boards to make the equipment safe for trainmen, the cost is chargeable to the owner in cases where owners are responsible for the defective condition. The cost of applying temporary hand railings to, or boarding over the openings on empty well-hole cars, is also chargeable to the car owner.

General Handling of Interchange

If a car has defects for which the owners are not responsible, the receiving line shall require that a defect card be securely attached to the car. Defect cards shall not be required for any damage so slight that no repairs are required, nor for raked or cornered sheathing, roof boards, fascia, or bent or cornered end sills, not necessitating the shopping of the car.

At outlying points where joint inspection is not in effect, the matter will be left to the judgment of the receiving line. Where chief joint interchange inspectors are employed, the decision will be made by the chief interchange inspector.

Defect cards shall not be required for missing material in fair usage from cars offered in interchange. Neither shall they be required of the delivering company for improper repairs that were not made by it.

Defect cards must be of the form prescribed by standard instructions. They must be of cardboard, printed in red ink on both sides, and must be filled in on both sides with ink or black indelible pencil. The cards must plainly specify in full each item for which charges are authorized, indicating the location of defects.

To justify bill, repairs authorized by defect cards must be made within two years from date of first receipt of car on home line, except wrong repairs, which must be corrected within nine months from date of first receipt of car on home line.

Any road making partial repairs of defects on a car which are covered by a defect card will have the defects repaired crossed off the original card with ink or indelible pencil and the card replaced on the car. A copy of the card accompanying the bill with the defects which were not repaired crossed off will be sufficient authority to bill.

Original Record of Repairs

When repairs are made to a foreign car (except as otherwise provided) or to any car on the authority of a defect card, a form shall be used for the original record of repairs, from which the billing repair card shall be made. This form embodies the minimum information required for the proper preparation of billing repair cards. Additions may be made to this form and its size made to suit the requirements of any company. This original record of repairs may be in book form if so desired.

A card similar to the above in its essential requirements, upon which repairs to more than one car may be recorded, may be used for recording minor repairs made in transportation yards.

In recording repairs upon the original record the following requirements must be observed:

(1) Cars shopped for repairs must be carefully inspected by an authorized person before the work of repairing is begun, and all work authorized by him must be entered upon the original record, including the location of each item of repairs and the exact reason or cause for making repairs. This information must not be assumed, but must be deter-

mined by an actual inspection. The common terms "broken," "bent," "missing," etc., if used, when caused by wreck, derailment, cornering, sideswiping or other causes must be qualified to show such cause.

(2) Special care must be taken to obtain a correct account of the material actually used. The finished sizes of lumber as applied to the car must be shown on the original record; feet, board measure need not be shown. The number and size of bolts, and the purpose for which they are used, must be shown upon the original record; the weights need not be shown. Nuts must be specified, except those used on bolts renewed, in which case an average of one nut per bolt will be assumed as used, regardless of whether double nuts are used.

The actual weight of forgings, structural or pressed steel shapes and weight and kind of castings must be shown on the original record in the space provided, except where the weight is accurately determined by definite description. Paint and nails must be shown on the original record; the quantity need not be shown in those cases where it can be properly determined by the billing clerks.

(3) All items carrying labor charges must be covered in proper detail on the original record; the time or money charges need not be shown. For items of labor computed on the rivet basis, the number and diameter of rivets must be shown on the original record. For items of labor for straightening or repairing, computed upon the weight basis, the weight of material must be shown on the original record.

(4) The original record must be signed by the authorized person making the original inspection and the person making the complete inspection or by other authorized person making the original record, to vouch for its correctness. The original records covering minor repairs made in transportation yards must be signed by either the person inspecting the repairs or the workman who repairs the car. All corrections made on the original record must be made by the person or persons who have vouched for the correctness of the original record by their signature.

Billing Work on Foreign Cars

These original records must be kept on file, for ready reference, preferably either at the point where repairs are made or the point at which they may be stored in accordance with local regulations. The billing repair cards must check with the original record of repairs, in so far as they should properly check as regards to details charges.

When repairs of any kind are made to foreign cars a billing repair card must be furnished the car owner, except as otherwise provided. This card must specify fully the repairs made, the reason for same, the date and place where made and the name of the road making repairs, and must also show the location of parts repaired or renewed.

When repairs are made to any car on authority of a defect card issued by other than the owner of the car, in addition to the billing repair card furnished the car owner, a separate billing repair card must accompany the defect card. This separate billing repair card must show the repairs made, details of charges, date and place where repairs were made; also references to the name or initial of the road issuing the defect card and the date issued.

If no bill is to be rendered, the billing repair card must be attached to the monthly bill, with the words "no bill" written across the face of the card, in which case the cards must be entered in the billing statement in the first four columns, with the notation "no bill" in the fifth column for reference.

The billing repair card shall be made in duplicate, the original to be known as the billing repair card and the duplicate to be known as the record repair card and to be of the forms prescribed, all items of repairs to be in handwriting or typewriting.

The following information must be specified on billing repair cards:

MCB couplers or parts thereof, R and R	New or second hand. Size of shank. Where 12¼ in. head coupler or type D coupler is removed or applied, it must be so stated. Riveted yoke or key attachment.
Wheels and axles, R and R	Cast steel, cast iron, wrought steel or steel tired wheels. New or second hand. Cause of removal (See MCB rule 10). MCB or non-MCB, length of axle, diameter and length of journal, diameter of wheel fit, diameter of center of axle. (Only one dimension for length of journal, diameter of journal or diameter of wheel fit to be given, which shall be the dimension nearest the condemning limit.) All markings on wheels and axles; if no marks are found, a notation to that effect must be made.
Journal Bearings	Box number (See MCB rule 14). New or second hand (relined journal bearings are considered as new). Solid filled or other kind R & R. Make or name. Length of journal. Box number (See MCB rule 14).
Brake shoes, applied	New or second hand. Cast or reinforced back.
Metal brake beams, R & R	New or second-hand applied, if MCB, and number of same, or non-MCB. Make or name. Cause of removal.
Triple valve, R & R	Make and type. When cleaned, must show "tested, per Rule 60" (when so tested), to justify charge.
Air hose applied	New or second-hand.
General	Finished sizes of lumber. Feet of lumber. Value of miscellaneous items. Hours of labor. (The above information to be shown opposite each item, except where no bill is rendered.)

When lead paint is used, it must be so specified.

When triple valve, cylinder or centrifugal dirt collector is cleaned, the initial of road and date of last previous cleaning must be shown.

If necessary to remove the load to make repairs, as specified, it must be plainly stated.

When tank or safety valve of tank cars are tested in accordance with the MCB specifications for tank cars, the certificate of test as required by the Interstate Commerce Commission regulations must accompany the billing repair card.

Interpretations Regarding Billing

Q.—Is it necessary to show the dimension for over-all length of axle, in addition to showing whether MCB or non-MCB length?

A.—No, the over-all dimension need not be shown.

Q.—Is it necessary to show how much of the flange, tread, rim, etc., is defective on wheels removed? Is the term "worn flange" or "chipped flange" sufficient without showing how thick the flange is when removed or how long the chip is?

A.—For cast iron or cast steel wheels it is unnecessary to show any dimensions or qualify the terms in any way, as it is assumed that the repairing line would not remove the wheels unless the defects were beyond the limit of safety. In so far as wrought steel wheels are concerned, it is necessary to furnish the information specified. In noting the cause of removal of wheels and axle, standard terms shall be used. In all cases of wrought steel wheels, the actual thickness of tread must be shown before and after turning off, measured from the base line of the tread to the condemning limit of the tread, which is ¼ in. above the witness groove; also show the actual thickness of tread on other wheels ap-

plied. This information must be reported to car owners regardless of whether or not repairs are chargeable to the owners.

Journal bearings having a babbitt lining 3/8 in. thick or thicker shall be charged as filled journal bearings, and not as solid journal bearings.

The evidence of a joint inspector, or the joint evidence of two inspectors, one representing the owner of the car and the other representing a railroad company, subscriber to the MCB rules, that the repairs are not proper, shall be final; the evidence to be signed only after an actual inspection has been made.

A joint evidence card should be used for this purpose, which shall describe and show the location of parts repaired or renewed. This card shall be of the form prescribed. If repairs are not corrected at the time of inspection, the joint evidence card shall be attached to the car. Joint evidence must be obtained within ninety days after first receipt of car home. The joint evidence may be obtained at any point on the home line at which the improper repairs are found, but preferably at the point where the car is received, and only after an actual inspection is made.

The joint evidence card showing copy of billing repair card covering wrong repairs, when wrong repairs have been corrected, shall be sent to the company issuing such billing repair card. If within 60 days from the date of such request the latter does not issue its MCB defect card covering, bill made on copy of joint evidence and copy of billing repair card shall be final authority, provided the wrong repairs mentioned on joint evidence card are covered by such billing repair card. It must be stated on back of joint evidence card where and when the wrong repairs were corrected.

The end of car toward which the cylinder push rod travels shall be known as the *B* end and the opposite end shall be known as the *A* end.

Facing the *B* end of the car, in their order on the right side of the car, wheels, journal boxes and contained parts, shall be known is *R-1, R-2, R-*c*, and R-3,* and similarly those on the left side of car shall be known as *L-1, L-2, L-3* and *L-4.*

Defect cards and joint evidence cards must be securely attached to the car with at least four tacks, preferably on the outside face of an intermediate sill between cross-tie timbers on wooden cars, and on steel cars to a cardboard located either on a cross tie under the car or on the inside of the sill at the end of the car.

Duplicate defect, billing repair or joint evidence cards must be furnished promptly, on request, for lost or illegible cards.

Any car having defects which render it unsafe to run, unsafe to trainmen, or to any lading suitable to the car, may be repaired.

Repairs to foreign cars shall be promptly made, and the work shall conform in detail to the original construction, and with the quality of material originally used.

Standards for Repairing Foreign Cars

In repairing foreign cars:

(a) Defective non-MCB standards may be replaced with MCB standards (which must comply with MCB specifications), provided such substitution does not impair the strength of the car. Any increased cost resulting from and any expense of alteration necessary for the application of such MCB standards shall be charged to the car owner. Scrap credits are to be allowed for undamaged parts thus removed.

(b) Malleable iron, wrought iron or steel MCB standards may be substituted for each other or for gray iron MCB standards, gray iron MCB standards applied in lieu of malleable iron, wrought iron or steel MCB standards shall be considered as wrong repairs.

(c) In replacing MCB standard couplers, MCB type D Couplers or MCB temporary standard couplers, the dimensions of shank and butt of MCB couplers standard to the car must be maintained, except that 9-1/2 in. butt may be substituted for 6-1/2 in. butt when used with MCB standard yoke in substitution for non-MCB standard yoke.

(d) If the car owner elects, on account of improper repairs, to remove an MCB standard coupler, MCB type D coupler or MCB temporary standard coupler in good condition, second hand credit should be allowed, and charge be confined to second hand coupler applied.

(e) MCB No. 2 brake beams may be used in repairs to all freight equipment cars equipped with MCB No. 2, MCB No. 1 or non-MCB brake beams. Any increased cost resulting from the application of No. 2 brake beams to be borne by the car owner. MCB No. 3 brake beams must be replaced in kind.

(f) The billing repair card must specify the kind of material applied and removed, and the bill rendered in accordance therewith.

(g) Cast-iron brake shoes may be replaced with brake shoes having a reinforced back and the increased cost charged to the party responsible for the repairs.

(h) White pine, yellow pine, fir or cypress may be used when repairing siding, when of equal grade or quality to the material standard to the car. Fir, oak or southern pine may be substituted for each other in the renewing or splicing of longitudinal sills and side plates. Oak and southern pine may be substituted for each other in renewing end plates. Fir and southern pine may be substituted for each other in renewing or splicing end plank and side plank.

(i) Brake shafts, sill steps, uncoupling levers and grab irons must not be welded.

Cotter keys are not to be applied to knuckle pins of couplers on cars other than hopper and fixed-end gondolas.

Interpretations—Q.—Does the substitution of a New York auxiliary reservoir and cylinder in place of a Westinghouse constitute wrong repairs?

A.—The substitution is permissible, inasmuch as these details are interchangeable and are of the same dimensions, and the substitution of one for the other is not wrong repairs.

Q.—We are having trouble in living up to the Interstate Commerce Commission rules regarding end ladder clearance, due to the fact that some railroads do not replace our couplers with those of the latest dimensions, namely, 9-1/4 in. from inside face of knuckle to striking face of coupler horn. What protection is offered under the rules?

A.—That end ladder clearance may be maintained, couplers of less than 9-1/4 in. from inside face of knuckle to striking face of coupler horn should not be applied in repairing foreign cars. This should not be construed to mean that a coupler with 9-1/4 in. dimensions may be submitted for the MCB temporary standard coupler or the MCB standard Type D coupler.

Q.—Will it be necessary to stencil cars equipped with the D type of coupler in order to protect them against substitution of the present type of coupler?

A.—Yes.

Q.—Is it permissible to charge for cast steel bottom brake rods applied to foreign cars when wrought iron is standard to the car?

A.—Inasmuch as the association has a standard bottom connection, it is permissible to make use of cast steel in this connection. The charge should be on the basis of material applied and the credit on the basis of material removed.

Q.—Is it permissible to charge for cast stel wehen cast steel column castings are applied in place of malleable iron standard to the car?

A.—Cast steel may be substituted for malleable iron but the charge should be limited to the kind of material removed. The association has no standard column casting.

Q.—Is it proper in cases where a K-2 triple valve has been applied in place of a G.N.-2 triple valve to scrap the G.N.-2 valve, or should the charge be confined to a charge for cleaning?

A.—If the car was built prior to Jan. 1st, 1915, no charge for this betterment could be made, except upon authority of the car owner.

Q.—In connection with the interpretation of the 1916 code of rules regarding the substitution of Westinghouse triple valves for New York triple valves, or vice versa, what triple vales manufactured by the Westinghouse and New York air brake companies are considered as being of similar types?

A.—The MCB standard K-1 and K-2 triple valves, manufactured by both the Westinghouse and New York air brake companies are the only triple valves that can be properly considered of similar type.

Improper Repairs

Any company making improper repairs by using material which the repairing line should carry in stock is solely responsible to the owners. Such improper repairs must be corrected within nine months after first receipt of the car on the home line, to justify bill.

The company making such improper repairs must place upon the car, at the time and place the work is done, an MCB defect card, which card must state the wrong repairs made.

In order that repairs to cars may be expedited as fully as possible, foreign or private line cars may be repaired by the handling line by using material from their own stock instead of ordering material from the car owner, in which event the repairing line is absolved from all responsibility for the cost of standardizing repairs thus made.

Interpreation: Q.—In the event of using wrong material from stock, instead of ordering correct material from the car owner, are such repairs chargeable to the owner?

A.—Yes, provided the original defects are owners' responsibility.

Companies shall promptly furnish to each other, upon requisition, and forward, freight or express charges collect from point of shipment, material for repairs of their cars on foreign line. If the material is for repairs of car owner's defects, the foreign company may bill the car owner for the entire freight charges, and in such case the car owner may reclaim freight charges for the portion of the movement over its own line. If the material is for repairs of user's defects, the foreign line may reclaim only for that portion or the movement over its line. A separate bill, with copy of freight, express or due bill attached, should be rendered for the freight or express charges, showing reference to the bill covering repairs.

Requisitions for such material shall specify that it is for repairs of cars, giving the number and initial of such car, together with pattern number, sketch or other data to enable correct filling of the requisition. Material weighing less than 250 lb. gross weight ordered from the car owner must be shipped by express.

The company having the car in its possession at the time shall provide from its own stock the following: Lumber, forgings, hardware stock, paint, hairfelt, piping, air brake material and all MCB standard material.

Interpretations: (1) Q.—If material is shipped by local freight to repair owner's defects, who should pay the cartage from the freight depot to the repair tracks?

A.—There should be no charge for cartage.

Q.—(2) What items are covered by the word "forging"?

A.—Commercial shapes, such as channels, Z-bars, etc., should be furnished by the repairing line. **Pressed steel shapes which require special dies for their forming should not be carried as forgings; such material should be furnished by the car owner.**

On May 14, 1919, the American Railroad Association Section 111—Mechanical—issued circular No. S-111-37, making certain changes in the rules of interchange. The changes again make car owners responsible for and therefore chargeable with, the following items of repairs, which prior to April 15, 1919 were not to be billed for.

1. Air hose gaskets, applied, except with hose complete, applied.
2. Bolts, 6 in. long or under, applied, except when used to complete items of repairs not herein listed.
3. Brake beam finger guard pins, finger guard pin castings, safety chain clips, safety chains, links or hook bolts, applied.
4. Brake hangers, repaired or applied, except with renewal or change of brake beam.
5. Brake hanger pins or bolts, applied.
6. Brake pawl, applied.
7. Brake pins or key bolts, applied.
8. Brake ratchet wheel keys, applied.
9. Brake shaft rings, applied.
10. Brake shoes, applied.
11. Brake shoe keys, applied.
12. Carrier iron, Bettendorf type, when turned over, no charge for adjustment.
13. Coupler release clevises, clevis rings or chains, clevis pins or bolts, applied.
14. Door hasps and staples, applied, except with complete door, applied.
15. Door seal pins or chains, applied, except with complete door, applied.
16. Journal box lids and bolts, or springs for same, applied.
17. Knuckle locks, applied, except with coupler, complete, applied.
18. Knuckle lock sets, applied, except with coupler complete, applied.
19. Knuckle pins, applied, except with coupler complete, applied.
20. Lag screws, applied, except when used to complete other items of repairs not herein listed
21. Nuts or lag screws tightened.
22. Nuts, applied, except those used in renewing bolts, other than bolts 6 in. long or under, where the latter are used in completing items of repairs not herein listed.
23. Nut locks, or lock nuts, applied.
24. Pipe fittings, union gaskets, pipe hangers, clamps, and cutting of pipe threads, except with renewal of any or all air brake on retaining valve pipe.
25. Refrigerator car door hooks, applied.
26. Rehanging side or end doors.
27. Release lever brackets, applied.
28. Release valve rods, repaired or applied.
29. Renailing sheathing, lining, facia or roofing.
30. Spring cotters and split keys, applied.
31. Straightening brake shafts and uncoupling levers when not removed from car.
32. Staples, applied.
33. Wood screws, applied, except when used in renewal of running board.
34. Washers, applied.

The circular also provides that defect cards shall be required as between all roads for cars having defects for which the delivering line is held responsible under MCB rules.

Defect cards shall also be required as between all roads for improper repairs made to cars as per MCB rules 12 and 13.

Delivering lines again become responsible to the receiving line for the cost of transferring or adjusting lading on cars as per MCB rule 2 and A.R.A. rule 15.

This circular also abrogated modifications *A*, *B* and *C* of the Interchange Rules governing passenger train cars, so that defect cards are again required for delivering line defects on cars offered in interchange, also wrong repairs made to foreign cars. Gas certificates must be issued to the delivering line to cover gas in holders of cars received and when passenger cars leave the road a gas certificate must be requested from the road receiving the car.

Interchange at Chicago

At Chicago, the handling of cars in interchange will be in accordance with the Chicago Car Interchange Bureau's instructions, a copy of which follows:

In accordance with American Railroad Association, Section III Mechanical Circular No. S-111-37 dated May 14th, 1919, effective June 1st, 1919, the cost of transferring the lading of freight cars or re-arrangement of lading at junction points in the Chicago Switching District, including the main line of the EJ&E from Waukegan, Ill. to Porter, Ind. shall be handled as follows:

FIRST: The delivering line shall pay cost of transfer or rearrangement:

(a) When transfer is due to defective equipment that is not

safe to run according to MCB rules, *except where the repairs can be made under load as per MCB rule 2.*

(b) When transfer or arrangement of load is due to contents being improperly loaded or overloaded, according to MCB rules, or the Interstate Commerce Commission regulations for the Transportation of Explosives and other dangerous articles by freight and by express, or when dimensions of the lading of open cars are in excess of the published clearances of any of the roads covered by the routing.

(c) When transfer is due to the delivering line not desiring its equipment to go beyond junction points.

(d) When cars cannot pass the approved clearances of the American Railroad Association.

SECOND: The receiving road shall pay the cost of transfer or re-arrangement:

(e) When cars cannot pass clearances, except as provided in paragraph (d), or when cars and lading exceed load limit or cannot be moved through on account of any other disability of the receiving line.

(f) When receiving road desires transfer to save cost of mileage or per diem.

THIRD: Transfer orders shall not be issued against belt or intermediate switching lines, except:

(g) For defective or improperly loaded cars when load originates on their rails.

(h) For defects which develop after receipt from trunk lines, providing defects existing on receipt of car were not the cause of subsequent damage which necessitated transfer of car, or readjustment of lading.

(i) Cars delivered to belt or intermediate switching line with defects which would make transfer necessary either by the belt or intermediate switching line or their connection, if transferred by the latter, the belt or intermediate switching line is to be relieved of the cost of transfer, and transfer order issued against the trunk line delivering the car to the belt or intermediate switching line.

FOURTH: Seven dollars per load will be charged for such transfer or re-arrangement, except in cases of adjustment of lading and application of door protection in house cars, a charge of two dollars will be made.

FIFTH: *All* roads in the Chicago switching district, in so far as the transfer of loaded cars or the adjustment of lading is concerned, shall arrange as follows:

(1) Car foremen, inspectors and others will be required to fill in all information on form 159-A and must also show on same what disposition was made of the car after it has been transferred, showing to what shop the car was carded for repairs after transfer, or if it is a Chicago owned car it must be shown that the car was carded home to the car owners for repairs. In cases where cars are transferred for old defects, or the lading is readjusted due to the car being originally improperly loaded, the form should be made out in quadruplicate and in cases where the cars are transferred or lading readjusted due to new damage or the lading is adjusted due to rough handling, it should be made out in duplicate and forwarded to the chief interchange inspector, who will issue authority for transfer or adjustment of lading against the road responsible.

(2) No authorities for transfer will be furnished for cars having the following defects:

(a) Defective wheels and axles under all cars.

(b) All other truck defects on home cars.

(c) All other truck defects on foreign cars, except metal bolsters, center plates, where cast integral with bolsters, metal truck sides, metal truck transoms and metal spring planks, also excepting non-MCB standard journal boxes and contained parts in cases where the MCB standard is not a proper substitute.

(d) Defective outside wooden end sills on all cars.

(e) Defective body center plate and center plate bolts that do not pass through center sills on all cars, except when such center plates are cast integral with bolsters on foreign cars; also center pins that are not applied from inside of car on all cars.

(f) Renewal of roof boards of outside wooden roofs, and of inside metal roofs, where such renewal does not exceed 25 per cent of the roof boards, and where purlines, rafters, ridge pole, side and end plates are in good condition, on all cars.

(g) Missing or defective side doors (except that an adjustment order may be obtained to apply proper door protection, as required by the Loading Rules), end doors, roo doors and hatch covers on all cars.

SIXTH: The repairs to car or transfer of lading is to be done by the railroad having facilities nearest available. If facilities are equally available by both railroads, the car will be moved to facilities located in the direction car is moving.

SEVENTH: Bad order cars which previously had been delivered in bad order under load must be repaired by the road making transfer if they have facilities and material; if not, the nearest repair point on any line, having material and facilities should make repairs—with the exception of Chicago owned cars, which may be delivered to the car owners for repairs.

At Minneapolis and St. Paul the handling of cars in interchange will be in accordance with the Twin City Joint Inspection Association Bulletin which is similar to the Chicago regulations.

At Minneapolis and St. Paul the handling of cars in interchange will be in accordance with the Twin City Joint Inspection Association Bulletin which is similar to the Chicago regulations. At Council Bluffs and Omaha the handling of cars in interchange will be in accordance with an agreement which is practically the same as the Chicago agreement. At Kansas City the interchange of cars will be handled in accordance with an agreement which will also be practically the same as the Chicago agreement. At other interchange points the interchange of cars will be handled strictly in accordance with the MCB rules, unless there be some local agreement to the contrary.

FREIGHT CAR ROOF CONSTRUCTION*

BY H. R. NAYLOR

It is interesting to note the progress made on this continent in car roof construction from the time when the outer covering consisted only of a single layer of boards having tongue and grooved joints. In many instances, I believe it was customary to use a wood shingle roof similar to that commonly used in house construction. Another method adopted, presumably to overcome the leakage, was to apply the roof boards lengthwise of the car, overlapping each other similar to clapboarding on present-day wooden buildings. This method of construction proved unsatisfactory, and gave way to the double board roof which can be seen on a large number of cars even today. This was a decided improvement over the earlier types of roof, especially when at a later date a layer of waterproof paper was applied between the first and second course of boards, which became known as the "plastic roof." This roof undoubtedly protected the lading for some time, but it eventually became waterlogged, and a method was then sought to prevent the water leaking between the joints of the top course of boards which rapidly destroyed the paper and bottom boards. This was overcome to a great extent by grooving the face of the top boards, the grooves acting as drains, carrying off the water, and protecting the joints from possible leakage. In fact, this is the most common type of roof to be found on stock and refrigerator cars at the present time.

The Sub-Metal Roof

The next step was a distinctly new departure, and brought into existence the metal sub-roof, over which a wood roof was applied for protection only. The roof framing consisted of a ridgepole, carlines and purlins, to which an addition was made in the form of cross rafters. The galvanized metal sheets were formed with corrugations, and fitted into suitable grooves in the ridgepole and rafters, providing altogether a fairly effective watershed. But it was not long before the usual complaints were being made about this new metal roof, owing to the grooved edges of the wooden rafters breaking away, allowing the metal sheets to sag and leak. This defect was eventually overcome by flanging the roof sheets, and applying a metal capping over the rafters, which enclosed the flanges of the roof sheets, making a continuous metal water-

*From a paper presented at the Canadian Railway Club by Mr. Naylor, who is assistant works manager, car department, Canadian Pacific Railway.

shed for the full length of the car. With a few later modifications this was the final attempt along the lines of a metal sub-roof.

Some of the principal objections to the metal sub-roof are that the roof sheets in time buckle up at the eaves, and work out of the grooves in the ridgepole. With the constant twisting and straining of the car superstructure, the metal sheets and caps are soon displaced and bent, and in making repairs to the outer wood roof the metal sheets are frequently punctured by nails carelessly driven, all of which result in damage to the lading. The outer wood roof also requires frequent renewal, on account of constant exposure, which is a rather expensive item when added to the cost of maintaining the metal sub-roof.

The demand for improved roof construction was then met by adopting a roof framing made of steel, as in other parts of the car; for instance, the wooden carlines which were bolted to the sideplates, and a source of constant trouble, gave way to the steel carlines of various shapes, riveted to the sideplates, in order to give greater rigidity and strength. Other parts of the roof framing were improved and reinforced in a similar manner, providing greater stability, which is most essential if the outer roof is to be protected from the racking and straining of the car superstructure.

Outside Metal Roofs

The demand for greater stability was largely responsible for an entirely new departure in roof design, for instead of placing the wood roofboards on the outside, as in the case of the metal sub-roof, the plan was reversed, the roof boards being applied direct to the roof framing, and the metal roof sheets used as an outer protection for the boards in addition to acting as a watershed. The roof boards in this case being applied direct to the roof framing had the effect of bracing the roof against cornering and bulging, and brought into extensive use the outside metal roof.

The outside metal roof usually consists of one course of 13/16-inch tongued and grooved boards, securely fastened to the roof framing, the outer metal roof being formed of galvanized iron sheets generally of No. 22 gage. At the junctions of the main sheets suitable weather-proof protection is provided by metal caps, formed in various ways to interlock with the flanged edges of the main sheets. The method of securing the outside metal sheets at the eaves is very different to that on the metal sub-roof. The roof sheets on the latter type are prevented from lifting by the capping and outer wood roof, the fascia boards securing the sheets laterally on the car, making nailing unnecessary at the eaves. On the outside metal roof the main roof sheets or eave flashings are flanged at the eaves and secured to the outside of the fascia boards. This difference in the method of attachment on the early types of outside metal roofs, which were not designed to allow freedom of movement at the roof sheet intersections, resulted in cracked sheets and a considerable number of defective roofs, but eventually this was entirely overcome by providing ample sideplay at the main sheet capping, and applying eave flashings, giving the roof the necessary flexibility to withstand the cornering, weaving and bulging of the superstructure.

Advent of the All-Steel Roof

We find roofs today built entirely of steel. In comparison with the composite roofs already described, the all-steel roof presents an entirely new departure in design, both in regard to framing and roofing. The roof sheets are usually of 1/16-inch galvanized steel, but in some instances the sheets are 3/32-inch thick and span the full width of the car, providing in themselves the necessary protection against puncture or other hard usage. Additional reinforcement can be obtained by corrugating the roof sheets at suitable intervals. The carlines in most cases are designed to provide ready means of connecting the roof sheets, in addition to supporting the roof, and bracing the superstructure of the car.

With the adoption of the all-steel roof, the question of flexibility becomes a very live subject. Some types provide for free movement of the roof sheets, in a similar manner to the flexible outside metal roof, while in others the roof sheets are flanged, capped and riveted together, forming in themselves an absolutely rigid roof. It is claimed for the first type that the roof should be sufficiently flexible to take care of the constant straining of the car body, while in the rigid type the roof is made strong enough to resist the straining of the body, and act as bracing for the superstructure.

The all-steel roof lends itself readily to the use of outside carlines, this arrangement giving the car a considerable advantage in loading space; other advantages being the reduction in fire risk, and final cost, owing to the life of the roof more nearly corresponding with other parts of the car and finally a greater safeguard against leakage is obtained by the use of thicker sheets, which resist corrosion and cracking to a greater extent, and as a result this type of roof is gradually meeting with more general approval.

An objection which is sometimes raised against the all-steel roof is the claim that under certain conditions it is liable to sweat, resulting possibly in damage to lading. For instance, freshly milled flour containing a high percentage of moisture, and which is usually hot when loaded, quickly raises the temperature of the car above that of the outside atmosphere. It is claimed that the metal roof being then subject to two widely varying temperatures commences to sweat, and that the resultant moisture is sufficient to damage the contents. It is questionable, however, if this is of enough importance to warrant special attention when building box cars for general service requirements, but as a measure of precaution effective steps are being taken to prevent the possibility of this occurring even under the most extreme conditions, and eventually there is good reason to believe that the all-steel roof will meet all requirements.

Conclusions

As previously mentioned, the double board roof is the most common type on refrigerator and stock cars today, and while it meets the requirements for stock cars, it is rather surprising that a better roof has not been previously adopted for refrigerator cars in order to protect more effectively the insulation. In making repairs to this class of car it is often necessary to renew the whole roof insulation, and ceiling, which have become waterlogged and decayed, owing to the poor protection offered by the double board roof. The entire side and end framing, with their insulation, are often affected in a similar manner, due to the water working down through the defective roof. These conditions are becoming better recognized, and as a result we find the outside metal roof now being adopted for refrigerator cars. Owing to the metal roof being a greater conductor of heat it might be necessary to increase the roof insulation, but the added cost would be more than offset by the saving in maintenance.

A car roof should be so constructed that repairs can be made quickly and at a minimum cost. The position of the roof in relation to other parts of the car does not lend itself to proper maintenance. Trucks, air-brakes and draft gear are constantly being inspected for indications of possible failure, but unfortunately, and all too often, the only warning received of roof failure is when the damage has actually occurred to the lading. Car roofs should, therefore, be as far as possible self maintaining. Corrosion is an important factor in modern roof maintenance and calls for a systematic method of painting, for it cannot be expected that the galvanizing will protect the roof sheets indefinitely. The best designed car roof will only last in proportion to the maintenance it receives, and the object should be to make the life of the roof equal to the life of the car.

Discussion

L. Brown:—Each year the average car goes on the repair track five times during the year. When a car is built the roofs are generally in good condition and very few are found leaking. The trouble is not in the new roofs but in the old roofs that have been inservice for some time, very few of which do not leak. In looking over the defects in these cars we see that the boards are split, nails get loose and rust away and allow the water to get in through the nail-holes; metal sheets when unsecured, get loose, distorted and punctured. Caps over the inside metal roofs frequently become loose and the water follows the nail holes to the inside of the car. Nails securing the parts on the outside metal sheets work up out of the side plates and through metal sheets; parts securing the outside metal sheets frequently allow the water to get around the sheets, which wear away by friction and become cracked over the side plates.

The all-steel roof has less objectionable features than the other types and the condensation of moisture has been overrated in proportion to its importance, and the shipments which are damaged by moisture are few compared with the damage caused by water leaking in from the outside. The condensation inside may be eliminated by proper ventilation or by the use of non-conductive materials on the inside.

Objection has been raised to the rigid roof on account of causing derailments, but there is little justification for that theory. I have made tests of various roofs on empty cars and loaded cars with various types of roofs, and find that the additional force necessary to twist the cars having rigid roofs is negligible. The rigid roofs are not blamed for derailments of passenger cars which have such roofs and travel faster, have greater side bearing movement and have permanently heavier loads.

E. V. Harrison:—From an operating standpoint it is not so much the damage to merchandise from the roofs as from the side sheeting. During the past few years in the case of new cars turned out we have not had any side sheeting, with the result that considerable damage has occurred not only to flour but to other merchandise as well. I do not want to give any secrets away to the industrial people, but this is a thing which we have had to contend with both in regard to claims and damage.

James Coleman:—There are more loss and damage claims as a result of leaky car roofs than from any other direct cause, and I think the time is coming when the all-steel car roof will be adopted universally for the reason that it prolongs the life of the car, and if well constructed and properly applied will last almost the life of the car. The question has been raised as to the sweating of the steel roof in cars loaded with flour, but I think investigation will show that responsibility for this rests principally with the people who load the flour and fail to take precautions to prevent claims for damage. In October, 1919, a circular was issued by the U. S. R. A. to fifteen railroads at St. Paul and Minneapolis, where an embargo had been issued against the loading of flour in cars with all-steel roofs.

(*Paragraph from U. S. R. A. Circular*).—Upon further investigation it has developed that where flour is loaded in a warm condition in any kind of a car, whether *all steel or all wood roof*, if the temperature of the weather is very low, there will be condensation of moisture, due to the fact that there is no ventilation in the car and consequently it will cause this sweating.

The Western Weighing and Inspection Bureau has issued instructions on this subject, which read as follows: "In the interest of claim prevention, we should endeavor to prevail upon the flour mill people not to load their flour in a warm condition into cars during extremely cold weather; but, if they do so load it, then the flour should be covered with paper in order to protect same against the drippings from the sides or roofs of the cars."

Some all-steel roofs are constructed with a means provided for ventilation at the eaves, and with this means any moisture deposited on the underside of the roof sheets will be evaporated by this circulation. This possibly would not provide circulation enough with hot flour in the car, from 60 to 80 degrees, but this means of circulation will provide for any moisture that may be deposited on the roof sheets under ordinary lading. In confirmation of this, I have never yet heard of a report of sweating of room except of reports made by the people of Minneapolis and St. Paul in loading flour.

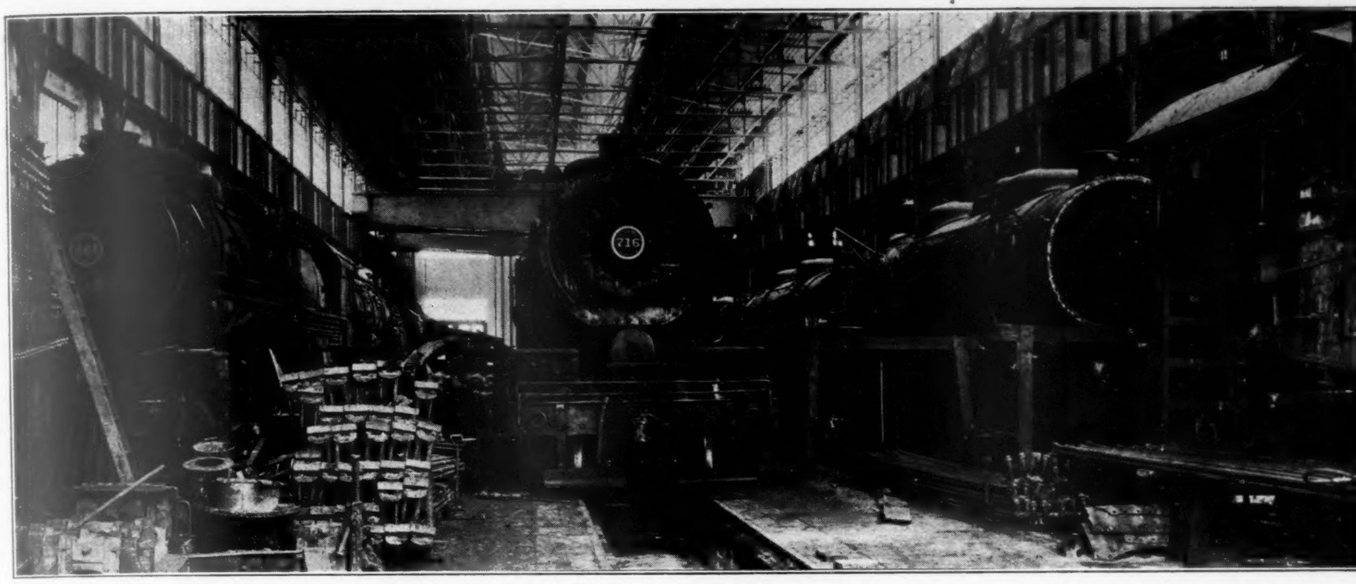
With the years of experience that these people have had at Minneapolis and St. Paul, they now admit that moisture will be deposited on a roof of any kind when the flour in the car is loaded at a high temperature, and they have given instructions that some covering—paper or tarpaulin—must be put over lading when loaded at a high temperature, in order to prevent the moisture dripping from the roof; either from a wooden or all-steel roof.

H. R. Naylor:—We are getting to the time when the modern car roof will take the form of an all-plate roof. For some time it has been more or less of a thin plate roof, but I think in the development of the all-steel roof, the tendency will be to use sheets of heavier gage, say ⅛-inch thick or heavier, thus making a good solid plate roof. When this is done the roof will more nearly last the life of the car, whereas today the average roof has to be renewed two or three times in the same period. By adopting a roof of this type, there should also be a tendency to avoid designs which are in any way complicated in order to reduce to the minimum the possibility of leakage, and enable them to be easily maintained. The roof, therefore, should be designed with the least possible number of sheet joints, the joints being formed and secured in such a manner as to make them absolutely weather proof. Providing the roof sheets are protected from the straining of the roof frame, there would appear to be no necessity of providing for flexibility. The superstructure should be well braced to protect the roof framing, and the roof framing should also be braced diagonally to protect the roof sheets from undue racking and strain. If we take care of the strains set up in the superstructure and transferred to the roof framing, then we should be able to use an all-steel roof of simple design, which need not necessarily be flexible.

W. J. Hyman:—A few years ago I examined a great many outside metal roofs that had been in service from four to six years, and on some of these roofs the paint was scaling off, on others along the edges of the carlines the weaving of the car had caused the paint to rub off and naturally they had started to rust. If some of our paint manufacturers could supply a paint which would stay on without scaling under extreme weather conditions and be elastic enough to take care of the weavings of the car it would go a long way in prolonging the life of the outside metal roof.

Norman Holland:—The question of being able to make a paint which will stay on roofs is extremely simple. You can make anything if the consumer will pay the price. It is possible to make a roof composition that will stay on cars. A sample I have consists of sixteen coats of such a paint and is made for passenger car roofs. It would be too expensive to make it standard for freight cars, although it might not be too expensive if you figured it out from the standpoint of maintenance cost. The point is that in dealing with freight car roofs you have to consider the joint in your board, and you cannot expect anything to be elastic enough to stand one half inch warping, and I have seen warps that were one and three-quarter inches.

Safety First.—Don't swing a sledge or hammer that you know is working loose on the handle, thinking it won't come off till "next time." You may not be hurt, but what about "the other fellow."

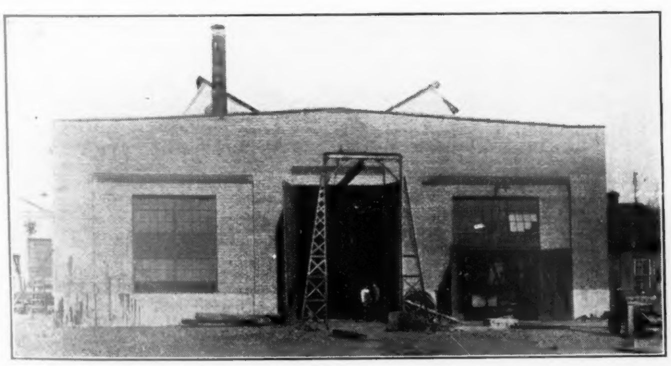


Interior of the Erecting Shop

EXTENSIVE ADDITIONS TO C. & O. SHOP

New Erecting, Machine and Blacksmith Shop and Brass Foundry Erected at Huntington, W. Va.

IN 1916 the Chesapeake & Ohio decided to enlarge the facilities for handling repairs to equipment at the main shops at Huntington, W. Va. The equipment owned by the road includes 923 locomotives, 395 passenger cars and 52,324 freight cars, and the increase in the amount of rolling stock as well as the increase in the size of the motive power necessitated an enlargement of the shops. Additional reasons for changes were found in the poor grouping of the existing buildings and the inadequate provision for lighting, heating and transporting material.



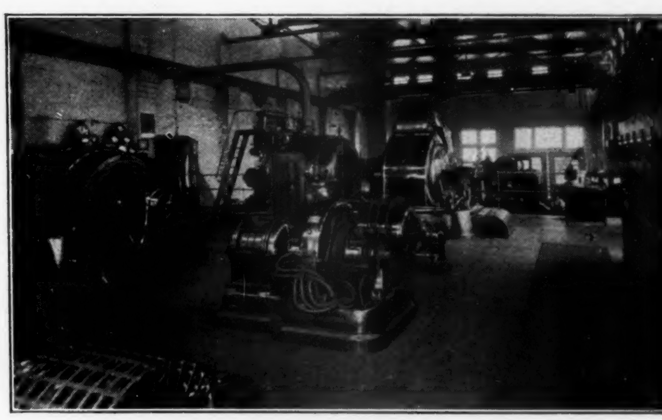
West End of the Blacksmith Shop

The site of the Huntington shop is a plot approximately 5,000 ft. by 850 ft., or about 100 acres, located north of the main line tracks. After a study of the requirements an expansion of the shop to three times the existing size was decided upon. Plans were laid for carrying out the changes without interfering with the operation of the shop and the improvements were divided into three stages. The first stage has now been completed, the second will probably be carried out in 1921 and the third without material delay.

First Stage of the Improvements

The work included in the first stage of the plan comprised the following steps: (1) the erection of a new brass foundry, increasing the floor area for this work from 8,500 sq. ft. to 14,000 sq. ft.; (2) the building of an addition to the blacksmith shop, increasing the area from 22,000 sq. ft. to 30,000 sq. ft.; (3) the removal of the machinery from the freight car blacksmith shop to the new addition to the locomotive blacksmith shop; (4) the erection of a new longitudinal erecting and machine shop at the north end of the existing machine, erecting and blacksmith shops; (5) the installation of a 10-ton traveling crane between the blacksmith and machine shops, extending from the new erecting and machine shop to the storehouse; (6) the enlargement of the transfer table pit and the installation of the new transfer table; (7) the rearrangement of the steam and gas piping and electric wiring.

The Arnold Company of Chicago was employed to assist in developing the plans and to handle the construction work of the first stage.

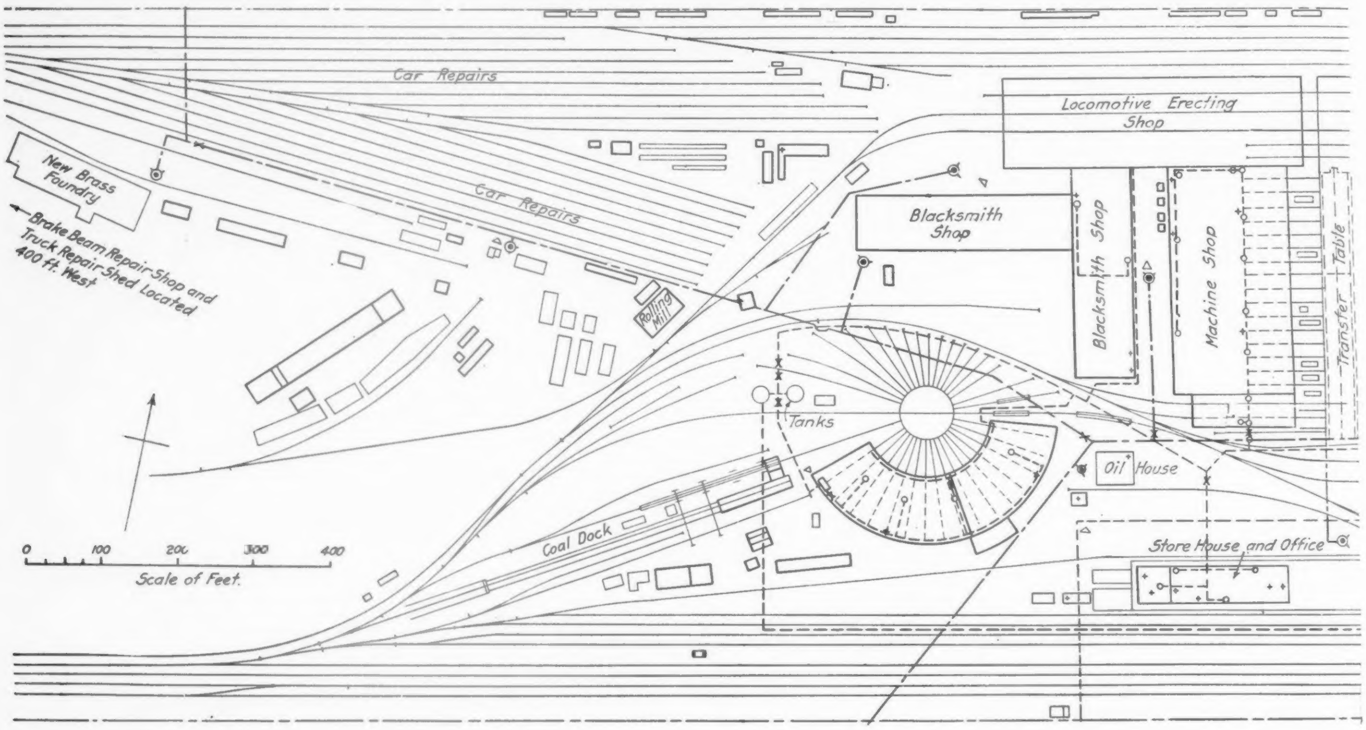


Interior of the Power House

Projected Improvements

Second Stage.—The second stage consists of: (1) the removal of the present transverse erecting shop, which has been

in service for 40 years, and the construction of a new and modern transverse erecting shop equipped with overhead cranes; (2) alterations to the present machine shop in the way of improved lighting and additional sanitary and toilet facilities and general repairs on the building; (3) an extension on the office building to provide approximately 11,000 sq. ft. floor area; (4) the construction of a new reinforced concrete, fireproof oil and paint storage house including storage tanks, pumps and modern oil house equipment; (5) an extension to the boiler plant to permit the installation of approximately 1,000 additional boiler h.p.; (6) the construction of a new lumber dry kiln and equipment; (7) an extension to the roundhouse; (8) the construction of paved roadways to displace a greater part of the present plank roadways within the shop grounds; (9) enlarging the boiler and tank shop.



General Arrangement of the Shops

West End of Erecting and Machine Shop, Blacksmith Shop at Extreme Right

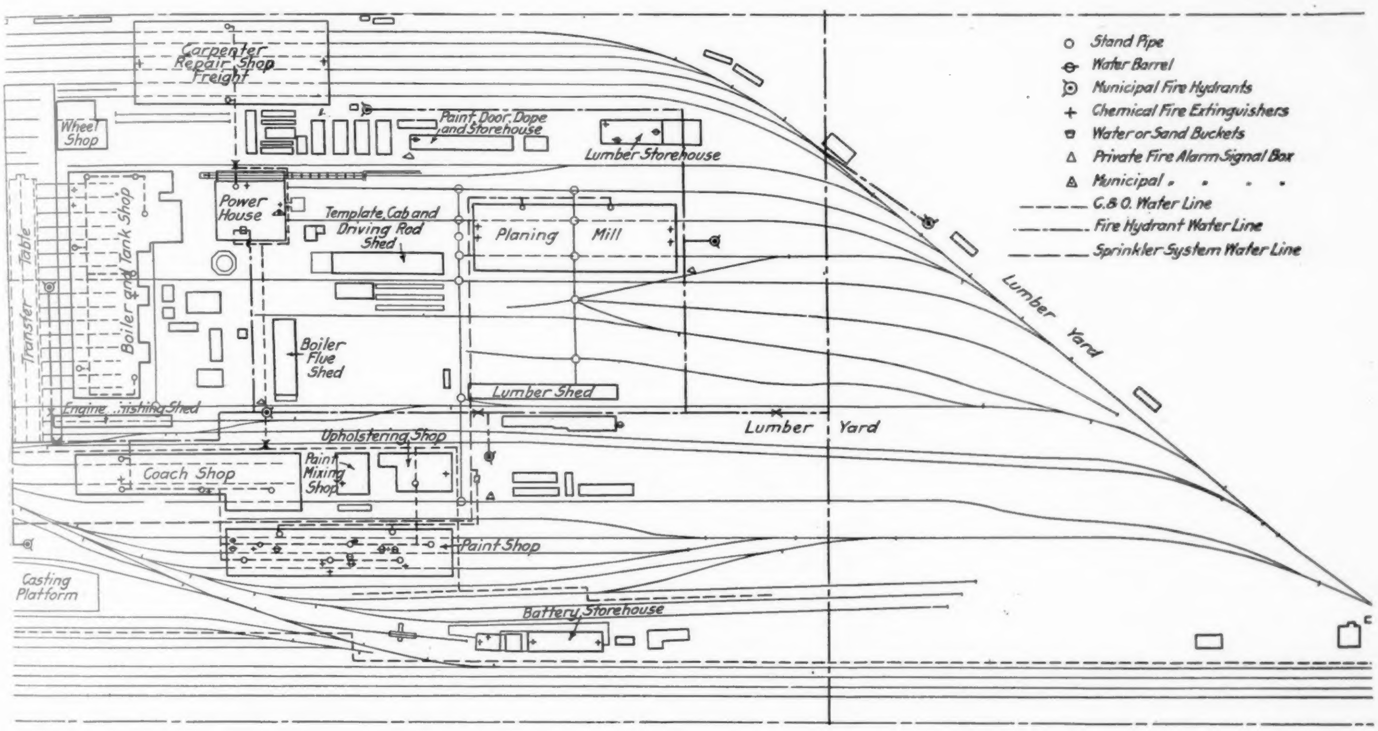
Third Stage.—The third stage consists of: (1) the filling of an area of low ground at the east end of the shop site and the construction of approximately 35,500 ft. of tracks for a new steel car repair shop and yard; (2) the construction of a new steel car repair shop approximately 1,200 ft. long, to shelter at least 68 steel coal cars undergoing repairs, this building to be equipped with modern traveling cranes; (3) the construction of a new freight car shop, blacksmith shop,

wheel shop and bolt shop complete with installation of equipment; (4) the construction of a new coach and paint shop and additional transfer table and pit serving this shop; (5) the construction of a new wood freight car repair shop for housing approximately 60 wooden freight cars undergoing repairs; (6) remodeling the present coach shop and converting it into a truck shop, tin and pipe shop, polishing and upholstery department.

With the completion of these new freight car repair facilities, the freight car work is to be removed from the present west end of the site available for a future extension to the locomotive repair shop and a large area available for a future reclamation plant and possibly an iron foundry. These three stages of the development, when completed, will be sufficient to take care of the needs for many years.

General Layout of the Shops

The facilities at Huntington shop include locomotive shops, car shops for both freight and passenger equipment, a brass foundry, a storehouse, an extensive reclamation plant and a complete engine terminal. As will be noted from the drawing of the shop layout, the tracks leading to the roundhouse leave the running tracks along the main line near the southwest corner of the shop grounds. These tracks also give access to the reclamation plant, to the west ends of the erecting and blacksmith shops and also to the south end of the



of the Chesapeake & Ohio, Huntington, W. Va.

Heavy Machine Bay in the Erecting Shop

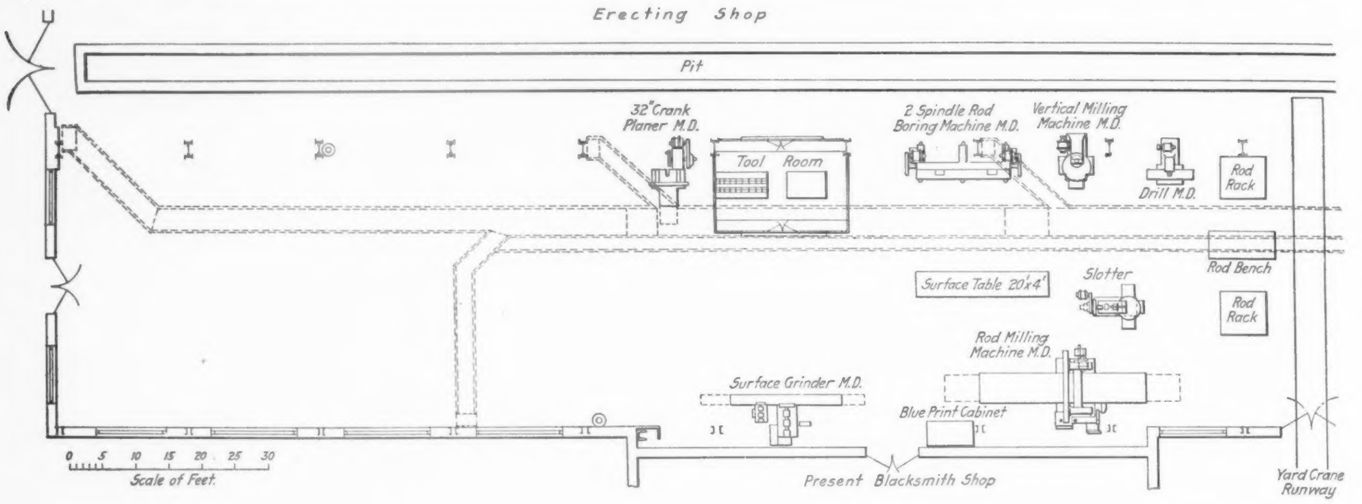
machine shop and the transfer table. The approach to the car repair shops and storehouse is from a lead at the east end of the shop. The locomotive shops can also be reached indirectly over these tracks. At the northwest section of the plot is a large car repair yard, served by two leads, and the brass foundry.

As the principal additions to the shops included in the first stage of the development, which was commenced in 1918 and completed in 1919, are all in connection with the locomotive facilities, the detailed description which follows is confined to that section of the plant.

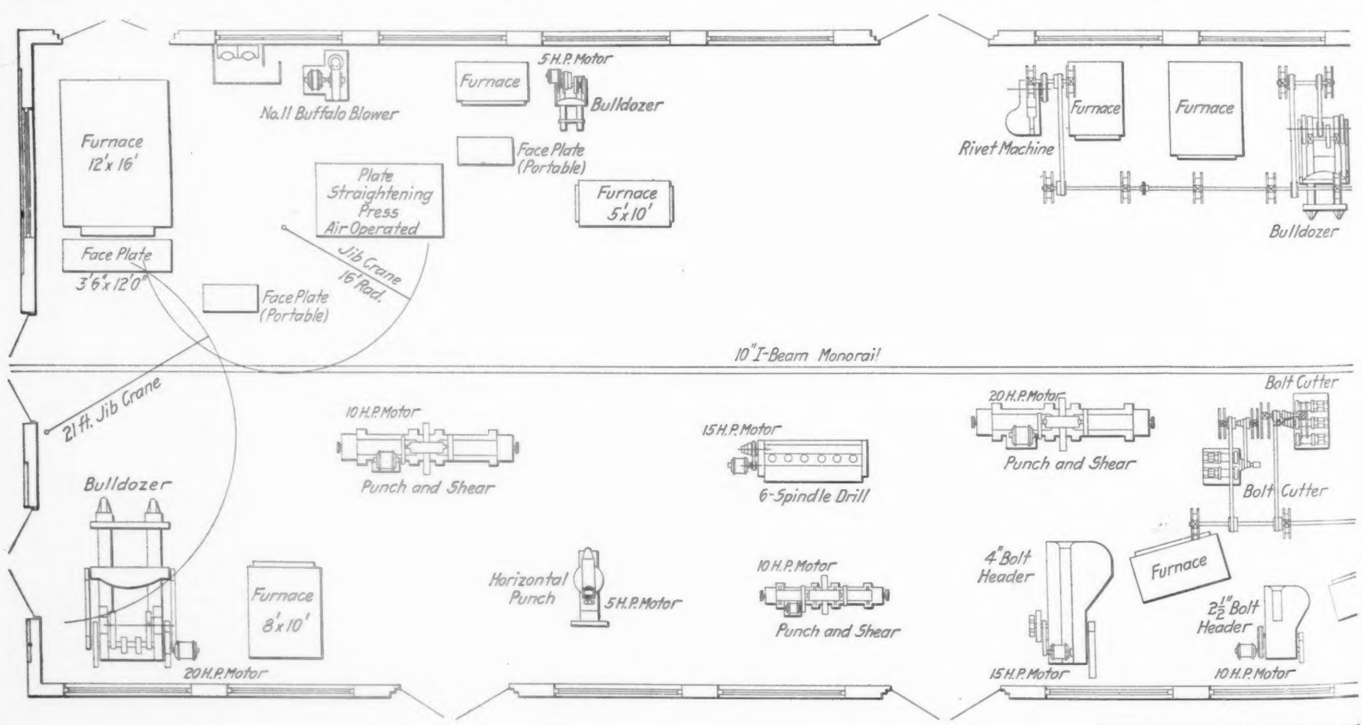
Erecting Shops

Locomotives undergoing repairs are placed on two sets of tracks, the Mallet and Mikado locomotives being shopped in the new longitudinal erecting shop, while the smaller power is set on transverse tracks in the machine shop building. The new erecting shop is 400 ft. long and 113 ft. wide. It is divided into an erecting bay 70 ft. wide and 41 ft. to the bottom of the roof truss, and a machine tool bay 43 ft. wide and 24 ft. to the truss. The building has concrete foundations and footings, concrete walls to the window sills, with brick side and end walls and pilasters. The framework and trusses of the superstructure are steel, over which is applied a wood roof covered with four-ply asphalt roofing. A ventilated steel sash is used in the side walls and monitors. The floor is of creosoted wood block over a concrete sub-base. Wooden doors of substantial construction are used. The erecting bay has two 150-ton cranes with auxiliary hoists of 10 tons and 5 tons capacity. The machine bay is served by one 10-ton crane.

The machine shop and blacksmith shop extend south from the erecting shop and at right angles to it. The boiler and tank shop is in a separate building at the eastern side of the transfer table pit, which has been enlarged. The rebuilt transfer table was made by extending the old table along practically the same lines but of heavier construction, as shown in the drawing, with the addition of more powerful motor, gearing and shaft. A special type of drive for the table was designed by the mechanical department with a



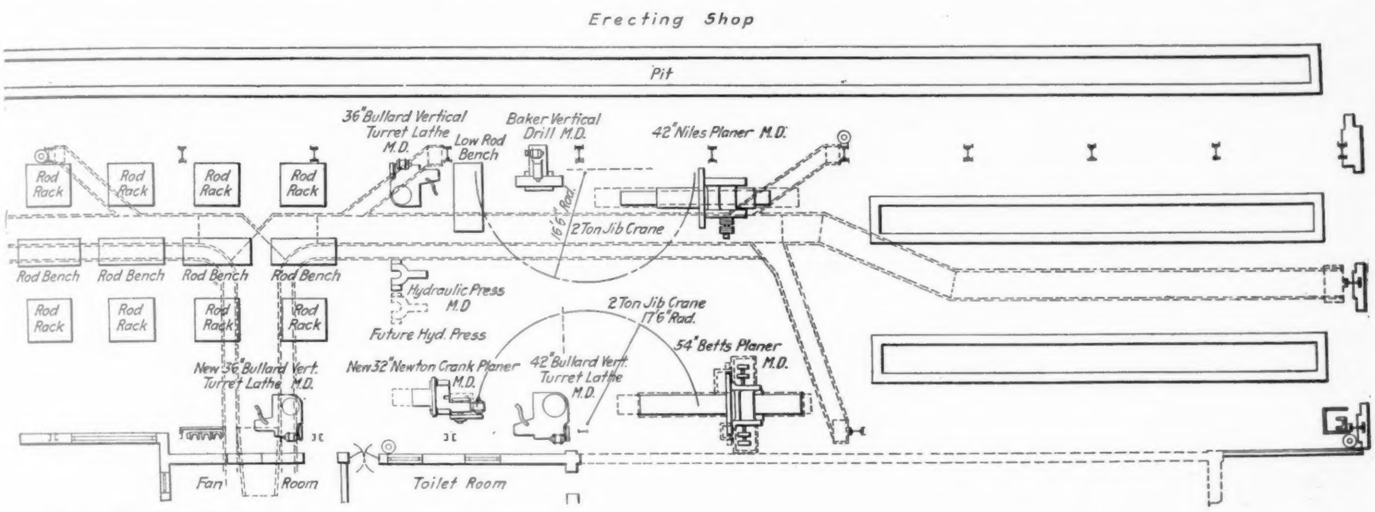
Layout of Tools In



Arrangement of Equipment

50 hp. 230 volt, D. C. crane motor geared to a drive shaft having shifting gears to mesh with the main drive of the table, or for driving the pulling drums, one of which is located at each end of the table for pulling engines on or off the transfer table.

Between the machine shop and blacksmith shop is a crane runway 50 ft. wide, which extends 520 ft. from the erecting shop, ending over the unloading platform at the storehouse.

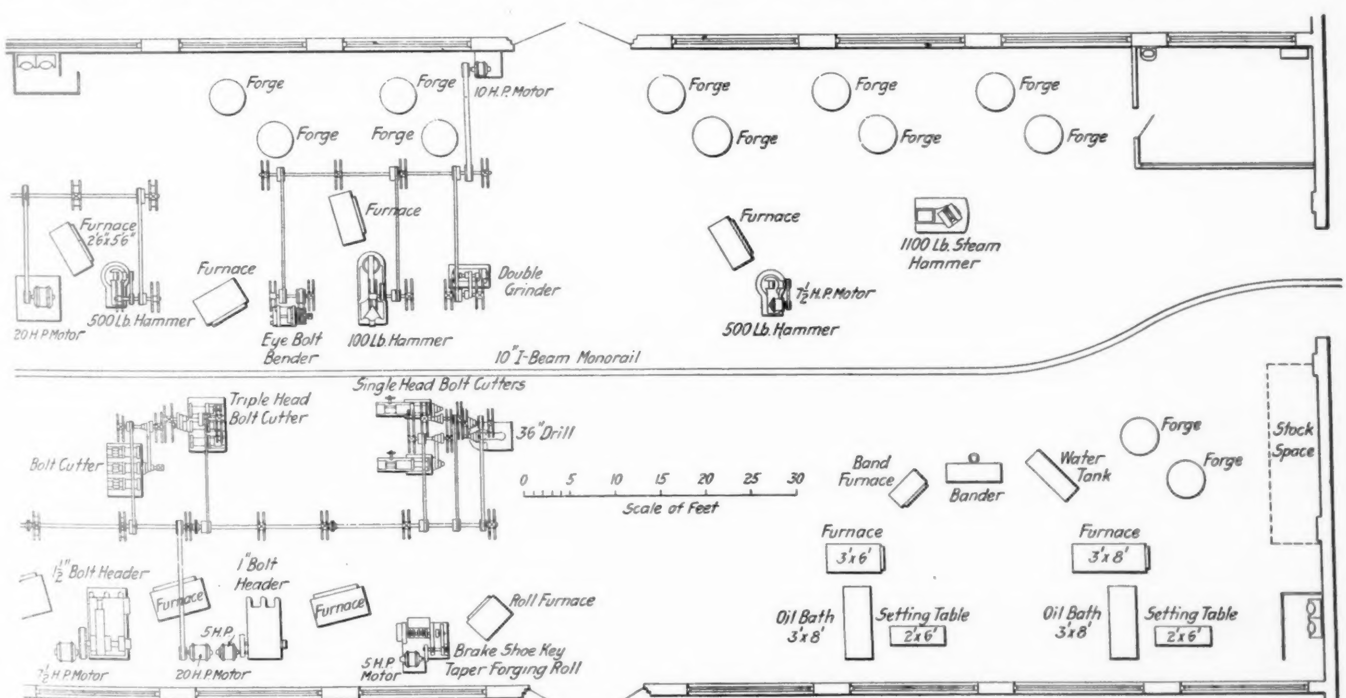


the Heavy Machine Bay

machine shop. The wheel department, which is located at the south end of the machine shop, is equipped with two axle lathes, a truck wheel boring machine, a boring mill for tires and wheel centers, a wheel press, and a 96-in. wheel lathe. Two wheel lathes of lighter construction are used for truing journals, for turning mounted wheel centers and similar work. On practically all locomotives on the Chesapeake & Ohio lateral wear is taken up by brass liners on the driving box and very little facing on the driving wheel hubs is necessary.

Locomotives enter the erecting shop by the center track at the west end or across the transfer table at the east end. They are stripped on this track and are then set on either of the two side tracks, each of which is long enough to hold four Mallet locomotives and two non-articulated engines.

In general, the parts removed for repairs follow a definite course through the machine shop or the heavy machine bay



In the New Blacksmith Shop

and are delivered to the erecting shop when completed. Driving wheels leave the shop by the transverse track leading under the crane runway, which furnishes considerable storage space. The driving box cellars are pulled out by the crane, then the wheels are taken to the south end of the machine shop.

The driving boxes after being cleaned in the lye vat are brought into the heavy machine bay and pass to the 100-ton vertical hydraulic press, where the crown brasses are removed and the hub liners cut off. New brasses are turned on a vertical turret lathe in the machine shop. They are then slotted to fit the box on the crank planer and are pressed in. A cast brass hub liner is then fastened to the box with brass studs, and the brass liners for the shoe and wedge fit are renewed if necessary. The shoe and wedge faces are then planed and the box is bored

and faced, the grease grooves being cut before it is removed from the chuck. Some boxes have the crown brass and hub liner cast in place. This work is done in the brass foundry, the boxes being returned to the heavy machine bay for boring and facing.

Main and Side Rods

The main and side rods after being stripped are placed on trestles in the machine bay. The bushings are removed with a hydraulic press and new bushings turned on the vertical turret lathe are pressed in.

New rods coming from the blacksmith shop are first milled on both sides on the slab milling machine. They are then taken to the lay-out table and the outline is laid out. The edges are then finished on the vertical milling machine and the slotter, except that the main section of the rod is finished on the slab milling machine. The holes for the bushings are then drilled on a two-spindle rod boring machine. The pistons and rods, valves and link motion are handled in the old machine shop, on tools and fitting benches grouped near the north end of the shop.

The new erecting shop is used exclusively for Mallet and heavy non-articulated locomotives. The lighter power is dismantled in a stripping shed at the south end of the machine shop, the engines being transferred to the 16 pits in the old machine and erecting shop or the two pits in the machine bay of the new shop by means of the transfer table, which has been rebuilt and enlarged to facilitate handling heavy locomotives.

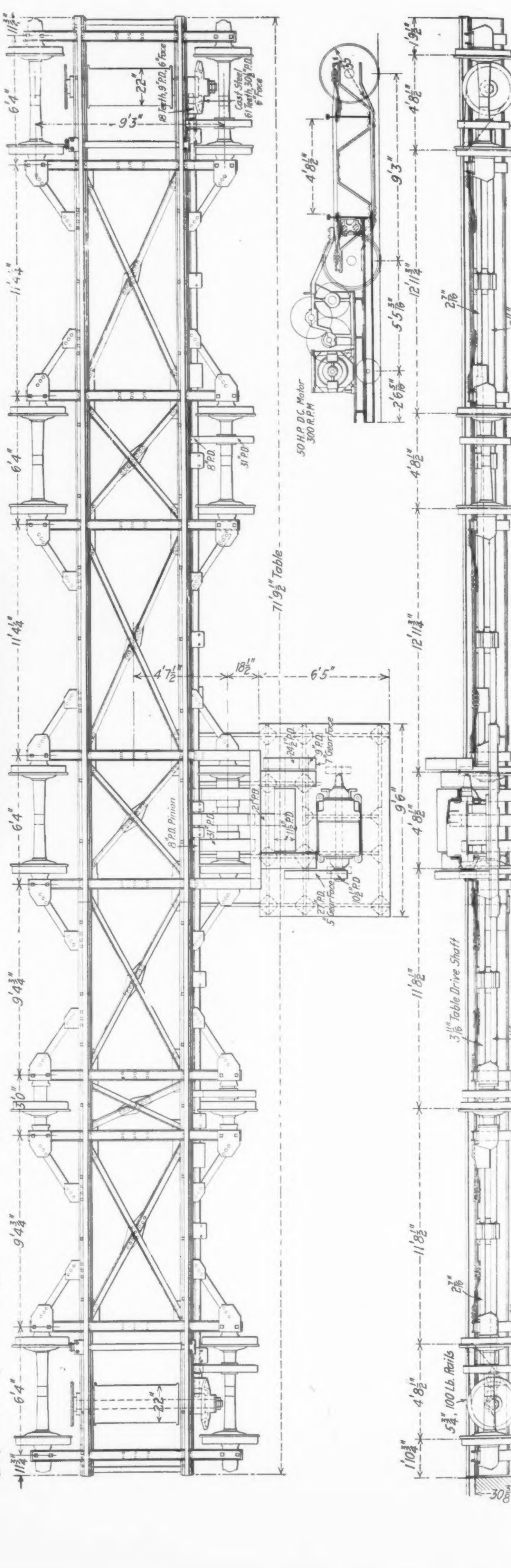
A Section of the Interior of the New Blacksmith Shop

Blacksmith Shop

The blacksmith shop occupies a brick building at right angles to the new erecting shop and an addition on the west side of the original blacksmith shop, which forms part of the new construction. The new building is 290 ft. by 72 ft., of the same type of construction as the erecting shop.

The heavy parts and locomotive work are largely handled in the older building. In the new shop are located the spring department and the facilities for handling the blacksmith work for cars. All the tools in this section are motor driven. A monorail crane running down the center of the shop facilitates handling heavy parts. The spring department is located at the extreme eastern end of the shop. A series of furnaces and forging machines is located along the center portion of the south wall. Adjacent to them are drill presses and bolt threaders, this arrangement making it possible to finish many of the parts completely before they leave the shop. Along the north side of the shop are six forges and near them are placed one 1,100 lb. steam hammer, Beaudry hammers and Bradley hammers.

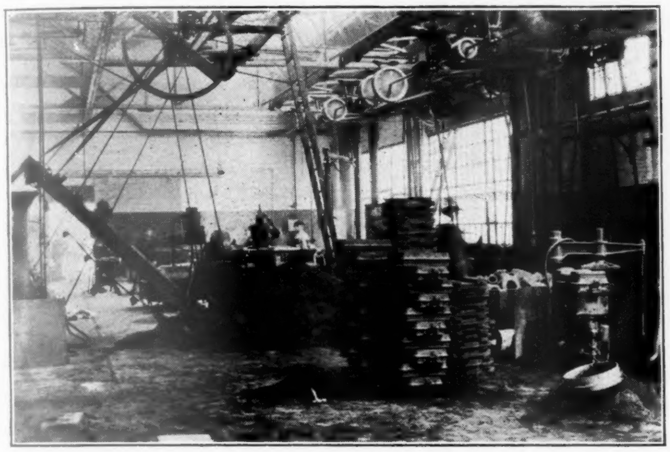
The west section of the shop is equipped for making steel car parts. In this section are three combined punches and shears, one 4-spindle arch bar drill, two bull-dozers, a horizontal punch and a pneumatic straightening press, besides the furnaces necessary for heating the work.



Powerful Transfer Table at Huntington Shop

Directly south of the blacksmith shop is a shed where bars are stored. Just outside one of the doors is a shear house where bolt stock is cut to length before being brought to the blacksmith shop. In this building there are a combined punch and heavy bar shear, a light bar shear and a washer press for manufacturing washers from scrap material.

The boiler and tank shop is located east of the turntable pit and has 16 transverse tracks. The north end of the shop is used for pipe and sheet metal work and an addition at the northeast corner is equipped for handling tubes and flues. The boiler shop tools are located along the east wall of the shop and are served by a monorail crane. The tracks are used principally for repairing tenders, as it is the practice to cut and flange the firebox sheets in the boiler shop and to assemble them within the boiler in the erecting shop, where they are welded and riveted.



East End of the Brass Foundry

Power House

The power house has six 275-hp. Sterling boilers, carrying 150-lb. pressure. Four of the boilers are fired with natural gas and two are fitted for burning coal and shavings, in order to provide for disposition of the refuse from the planing mill. The boilers are completely equipped with steam flow meters and are fed through a Cochrane metering heater fitted with a graphic recorder. An additional open heater is located in the basement of the power house and a cooling tower is placed outside of the building.

In connection with the installation of the second heater a unique method of testing boilers in the erecting shop was installed. The feed pumps connected to the open heater now lead through a main to the erecting shop. A pressure of 125 lb. is carried on this line and in case boilers are to be tested this pressure is raised to the desired amount by two portable electric triplex pumps in the machine shop.

The electric generating apparatus consists of two 750-kw. Curtiss turbines, direct-connected to an alternating current generator, with a capacity of 1,120 amperes at 480 volts. There is also a 25-kw. turbine for excitation and a motor generator set driven by a 35-hp. induction motor. The direct current required for the shops is furnished by a motor generator set of 250 kw. capacity. Compressed air is provided by two steam driven compressors, with capacities of 2,130 and 3,300 cu. ft. per minute, and a motor-driven compressor, with a capacity of 1,730 cu. ft. per minute.

The first stage of construction included a general rearrangement of service pipe lines and electric transmission lines to serve the new shops. An addition to the engine room of the power house was built to provide for the installation of the 1,730 cu. ft. capacity direct connected synchronous motor driven air compressor.

Brass Foundry

The brass foundry is located in a new building, which is situated at the extreme west end of the shops. The building is of concrete and brick construction with a double monitor roof and is 288 ft. long by 58 ft. wide. The location is convenient for receiving material and is also adjacent to the freight car repair yard, where a large number of brasses are used. The finished material going to the storehouses is readily handled on electric trucks; that shipped to outside points is loaded directly into the cars at the brass foundry.

The extreme western end of the foundry is used for coke storage and adjacent to this is a row of eight pit furnaces for melting in crucibles. The core ovens are located at the sides of the furnaces. The molding floor extends from the furnaces beyond the center of the shop and on the north side there are two Rockwell and one Monarch tilting furnaces fired with natural gas. Along the north wall on either side of these furnaces is a series of bins with doors opening outward, thus making it possible to unload the scrap brass directly from the cars into the bins. A magnetic separator is placed adjacent to the bins used for brass turnings. A monorail track carrying a one-ton hoist is installed in front of the scrap bins and the two sets of furnaces. Another track forms a loop over the molding floor. In addition to this the molding floor is served by six small cranes with one-ton chain hoists.

At the eastern end of the molding floor there is a pair of Nichols molding machines and a Berkshire molding machine, all of which are used for making journal bearings. Just east of the molding floor is the section in which the bearings are babbitted and other castings finished. Two tumbling barrels are located in a small lean-to on the south side of the shop. Along the south wall are located a sprue cutter, two stand grinders, a two-spindle boring machine, a swing grinder and two babbitt furnaces. These furnaces are used for babbitting crossheads and similar work and two other furnaces are provided at the north side of this section, one of which is used for melting off the babbitt and the other for tinning and babbitting journal bearings. The extreme eastern end of the building is used for storage of the finished castings. For convenience in loading outgoing shipments the room is provided with a pneumatic elevator. A dial scale is used for weighing castings. The space above the casting storage room is used for the storage of patterns. Adequate provision has been made for the comfort of the workers. Above the scrap bins east of the tilting furnaces are located locker rooms and shower baths. This foundry has a capacity of 15 tons daily and supplies brass castings for both cars and locomotives for the entire C. & O. system.

View Looking West in the Brass Foundry Showing Molding Floor and Tilting Furnaces

All In A Day's Work*

Hot Boxes, Derailments and the Grievance Committee Add Interest to the Life of the General Foreman

BY M. S. ROBERTS

EARLY one morning during the recent severe winter weather, I called at the office of a general car foreman at a busy terminal, to investigate with him certain conditions which were causing an epidemic of hot journals on through passenger trains.

I had known John Swinton, the general foreman, for many years, and so walked, unannounced, into his private office, where I found him busy at the telephone, getting a line on train detentions from the dispatcher, and, judging from the appearance of his memorandum pad, there had been a considerable number.

"Jim," said John, after greeting me most cordially, "it looks as though we would have to give the cars on trains 1

In a Few Minutes John and the Committeemen Came Out of His Office

and 15 extra careful attention for a few days, because these two trains have been performing"—Here the telephone demanded immediate silencing.

"Hello, chief; this is Swinton talking."—"What do you say? Broken arch bar on the wrecking derrick! Fine business. They were just returning from a derailment at ZX to clean up a bad mess in our passenger storage yard."—"Did Jones tell you how long it would be before he could move?"—"Good! One hour's delay won't tie us up here too badly, and I will say that it certainly pays to carry these repair parts on the wrecking outfit."—"Sure thing, you can see what it would mean if we had to send the arch bar out to ZX from the terminal."—"Good-bye, chief."

"Well, Jim," resumed John, "getting back to our hot journals. I was about to say that trains 1 and 15 burned things up pretty badly again last night, and you and I had better camp out on the equipment this morning to see if anything is being overlooked in the yard. Let's start now while the going is good."

On the way out we met the grievance committee coming in to see John, so he asked me to make myself comfortable in the outside office while he heard the men's complaints. The session was surprisingly brief, for in a few minutes John and the committeemen came out of his office. They were all apparently quite happy and it seemed probable to me that the men had carried off most of the honors in the argument.

"John," I remarked, "it did not take the boys long to put it over you that time."

"You are quite wrong, Jim," said John, smiling, "for it was more nearly the other way around. Two cases were discussed: the first one involved a shortage in a man's back pay adjustment, due to an oversight on the part of our timekeeper, and will, of course, be promptly adjusted; the second case presented proved to be without foundation, and after I had read and explained a couple of the rules of the National Agreement to the committee, they admitted their error and promptly withdrew the grievance. So you see, Jim, the meeting was mutually satisfactory."

"This is certainly a surprise to me," I exclaimed, "and if it is a fair sample of your sessions with the grievance committee, you certainly are more fortunate, or probably more diplomatic, in handling men than are many supervising officers of my acquaintance."

"I don't know about the diplomacy part of it," laughed John, evidently pleased by what I had said, "but I do know that boys here have a very fair attitude toward the company, and they seem very willing to be set right when they make errors in applying the many orders, supplements, amendments, addenda, interpretations, rules and docked decisions, with which we have had to struggle during the past eighteen months. They are not apt to present grievances until they are reasonably sure of their ground, and for this reason, I believe, do not spend their time and waste mine by following me around the territory bringing up petty grievances."

"On the other hand," he continued, "we have made an honest effort to line up to all the awards and agreements covering wages and working conditions. The men know our attitude and feel that they have been given a square deal. Confidentially, I feel that dealing with the men through their committee has been to my advantage rather than the contrary, because the disciplinary effect of this method on the rank and file has, so far, been wholesome. Of course, I probably would feel very different if the committee members were inclined to be radical, but, fortunately, these men have, up to the present time, proved themselves to be very fair minded and reasonable."

I was most interested to hear what John had to say on this important subject. There is no doubt in my mind that his success in dealing with his men is the result of his broad-minded attitude toward them, to which they naturally responded in kind.

Without further interruption, we proceeded to the passenger storage yard and began making our inspection of the journals, bearings and packing on the equipment which had been causing so much trouble of late.

Several journal bearings were found which showed signs of linings starting to crush out at the sides, and, on removal, most of them proved to have linings slightly cracked along the crown. I was strongly of the opinion that this condition was caused by excessive pounding due to lack of resilience of the track on account of the severe cold weather and deeply frozen roadbed; all of which resulted in subjecting the jour-

*Entered in the *Railway Mechanical Engineer's* prize story contest.

nal bearings to an abnormal shock, and the consequent cracking of the weakest part thereof, namely, the linings.

John agreed with me, but pointed out another serious feature, which he claimed to be at least an important contributing feature in causing the hot journals. The journal box packing now being furnished as a substitute for long fibre wool waste is of a very inferior quality. It disintegrates after a few days' service and becomes very soggy, and, in this condition, soon resembles soft mud. Lubrication, under these circumstances, becomes questionable and there is little doubt that many hot boxes can be charged to this kind of packing.

We discussed this matter thoroughly and decided, until such time as a better grade of packing became available,

John Agreed With Me, But Pointed Out Another Serious Feature

to use a mixture of reclaimed long-fibre wool packing with the inferior grade of packing now in stock, because some benefit could be secured from the springy action of the old packing and it would, at the same time, result in better capillary transmission of the oil to the journals.

We had just about completed this inspection and had made arrangements to repack all the journal boxes on the two trains, when a messenger handed John a rush communication. After reading it he said, "It looks, Jim, as though we would have to part company for the rest of the day, because the pleasant tidings which I have just received direct me to meet one of the federal inspectors, right away, and to accompany him while he makes an inspection of freight car repairs on the repair tracks. If I can get away from him on time, I am expected to attend the regular monthly safety meeting in the superintendent's office this afternoon."

I then suggested that I would gladly look over more of the passenger cars and would let him know later in the day whether I had anything more of a remedial nature to offer.

"Thanks, old man," he said, evidently relieved at my suggestion, "I hate like the mischief to leave you this way, but it is mighty fine of you to give me the benefit of your experience, and I trust that you can spare the time to go over the other trains. Well, so long, Jim, I must hurry now. It would not do to keep my friend from Washington waiting."

Shortly before six o'clock that evening, I went back to the general foreman's office, half expecting not to find him there so late. But he was in, apparently having arrived there just ahead of me, for he was looking over a couple of reports which covered the day's output of the freight and passenger repair tracks.

After briefly telling him what I had observed in connection with journals and lubrication since he left me, earlier in the day, I asked him if he had reached the safety meeting in time. "Yes, indeed," he answered, "I was able to satisfy the Federal man in a very few minutes. He was interested, principally, in keeping light repair cars moving from the repair tracks promptly. We have been making a campaign on this very thing for several weeks past, and our records showed to his complete satisfaction that, practically without exception, no light repair cars are being held over night. So he did not stay long with me, and I had just time enough left to get a bite to eat and to make the safety meeting on time.

"Jim, you have certainly put in a very full day, and I appreciate the assistance you have given me. There is a train leaving in about ten minutes, and you had better start for home," he urged, "or else your good wife will think some accident has befallen you."

"You had better call it a day yourself, John," I argued.

"Not for a little while, yet," he said, "I will go as far as the station with you, but I still have to see the night foreman for a few minutes and then I will go home."

"I don't suppose you have many days as busy as this one has been, do you, John?" I asked.

"Why, this was what I would call an average day," he laughed, "and, if the telephone behaves at all well tonight I will consider that it has been a very satisfactory day."

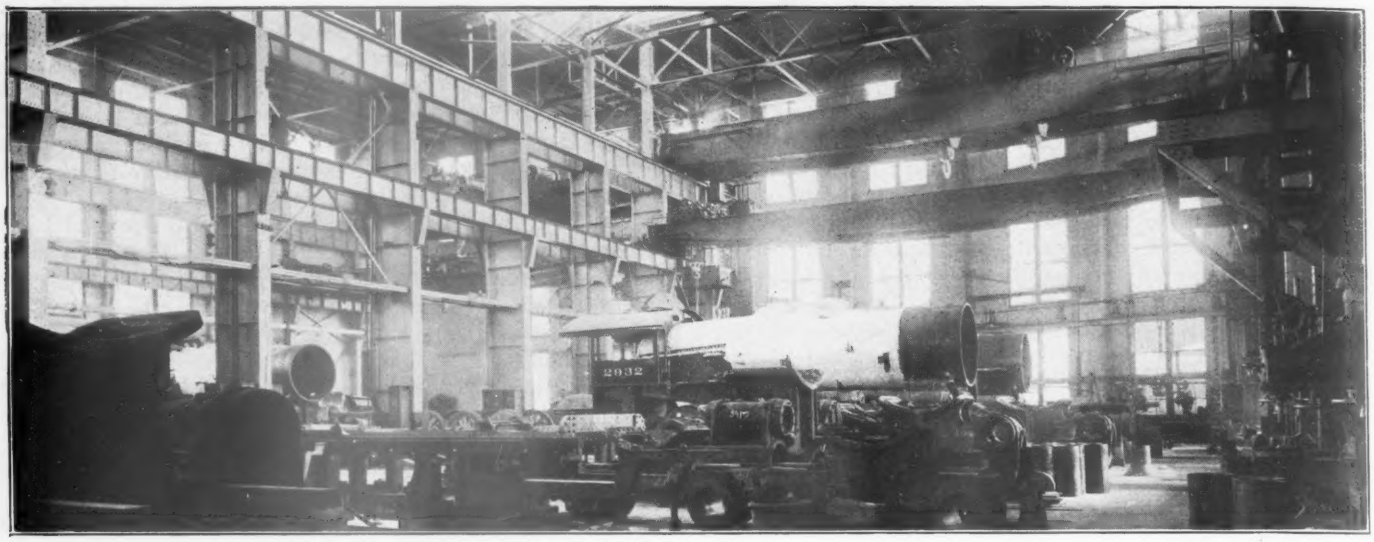
By this time we had reached the station and, after bidding John good-bye, I hurried for my train.

As I traveled homeward that night, I could not help thinking how typical my friend is of the great majority of rail-

I Went Back to the General Foreman's Office Half Expecting Not to Find Him There

road operating officers—cheerful, uncomplaining, serene; most congenial when busiest; and blessed with an optimism taught by years of exacting railroad experience. There is surely romance in their day's work, even though they probably never think of it in just that way.

MR. MCADOO'S INFLUENCE.—Horatio Alger's heroes may have to look to their laurels, according to a Canadian paper. A callboy of the Grand Trunk is likely to write his career as "From call boy to president." No clock watcher is this youngster. He has just drawn a pay check for two weeks, for $109.35, the result of his overtime efforts as a call boy. At this rate he is drawing a salary on the basis of $218.70 a month, which is more than the chief clerk—his boss—receives. Several other officials admit that he is getting more than they, says our Canadian contemporary, "but they explain that the scale set in the McAdoo award is responsible for the anomaly."



Some Notes on Erecting Shop Practice

A Definite Program and Attention to Details are Essential to the Operation of an Erecting Shop

BY C. P. HUBBARD

Erecting Foreman, Hornell Repair and Construction Corporation, Hornell, N. Y.

THE purpose of this article is to enumerate the various operations performed in the erecting shop in making standard classified repairs and to recommend performances for each class of repairs rather than to describe the operations themselves. The ever-increasing size of power is emphasizing the necessity of having the back shop relieve the roundhouse of heavy repairs, and as this work generally comes under the present Class 4 and 5 repairs, these operations should be distinguished from those performed in Class 1, 2 and 3 repairs. Important betterments, such as the application of superheaters, outside steam pipes, improved cylinders or valve gears, can best be made while undergoing Class 1 and 2 repairs, as when Class 3 repairs are needed the boiler and cylinders are often in good condition and require routine repairs only.

Advance information of the condition of the locomotive should be furnished so that the necessary material will be available without delay, and a comprehensive report made from observation of the locomotive in service should accompany it to the shop. When Class 4 and 5 repairs are required the report will indicate the necessity of testing cylinders and steam pipes, but these tests should always be made when making other classes of repairs.

Dismantling can best be performed by a separate gang, who will remove, clean and deliver the various parts to the proper department with their report of defective or missing material. This gang will also make the preliminary test of the boiler and cylinders and with the inspectors report their findings.

Light Classified Repairs

While preparing for Class 4 and 5 repairs, when the removal of all drivers is not intended, a careful inspection of all parts should be made in order that nothing will be overlooked that would necessitate the further removal of drivers until the next shopping. It is considered good practice by some, whenever any driving boxes require attention, to remove the complete set for a more detailed inspection. All motion work, spring gear, brake rigging, frames and connections are to be examined and put in condition for the mileage expected. Steam chests, crossheads, cylinders, steam pipes, tubes and flues and all other parts are to be made fit, so that they will not require overhauling until the next shopping.

When all wheels are removed the shoes and wedges should be lined, as required in Class 3 repairs, with the exception that driving boxes and shoes and wedges that are in good condition may be trued up, as they should run until the next shopping before going to the expense of bringing the entire set to standard. Eccentrics should be turned if found worn over 1/16 in. and their straps reduced, if needed, or replaced if the lateral motion is in excess of ⅛ in. Engine truck and trailer truck boxes and bearings are to receive needed repairs, main reservoirs are to be tested unless the date thereon indicates that they will run until the next shopping before the test is due. Air brake equipment, lubricators, injectors, safety valves and other appliances should be cleaned or repaired, so that the engine will be able to make the mileage required without the removal of heavy parts by the roundhouse force.

Handling Heavy Repair Work

In taking up Class 3 repairs the fact should be borne in mind that the work on the parts mentioned above is the same as required for the same parts in Class 1 and 2 repairs. As full mileage is expected, the engine is to be stripped of all parts under the running board, except such frame connections as show unmistakably that they need no repairs. The frames are now to be thoroughly cleaned and whitewashed. After the frames are dry they are to be sledge-hammer tested for defects and all bolts examined and removed unless in perfect condition. Particular attention should be given to cylinder and frame splice bolts, and if doubt exists as to the condition one bolt should be removed where the question arises and examined to determine the advisability of removing further bolts. If then there is any doubt as to their condition it is better to remove all bolts, as repairs of this kind between shoppings will reflect badly on the erecting shop. All bolt holes should be trued up with standard reamers and good-fitting bolts applied. Frame crossties and pedestal braces are

now to be adjusted to fit in place, worn pedestal jaws trued up and, if needed, restored to proper shape by autogenous welding. Where spring hangers are liable to chafe the frames a steel liner may be bolted or welded in place. Particular attention should be given to the guide yoke, as generally it will be found in need of some repairs. Boiler supports will need some attention, and where shoes are used under the front they will require trueing up and lubricating. Worn draw castings can often be reclaimed by autogenous welding, but they should receive special attention in regard to the condition of the draw bar pin holes and the connection to the frames, as they are hard to repair between shoppings.

When the frames are bolted completely and the pedestal braces are in place with the jaws finished, the centers are to be laid out on the main jaws. This may be done in any recognized manner, but the prevailing practice is to use lines parallel to the frames with a straight edge set square and proving the centers by it. With the main centers located, the other centers are marked off and the shoes and wedges put in place and laid out. The importance of accuracy in this operation is very great, and accurate machining of driving boxes should be insisted on, as the engine wheels will not tram properly if poor work is allowed. A standard proof mark on the shoes and wedges will determine if any liners are required, and in planing, if the shoe or wedge will not true up to the proof, it should be planed so that one liner of standard size boiler steel, not less than 1/8 in. thick, may be used, this liner to be securely riveted in place.

All spring rigging should be thoroughly overhauled, attention being given to see that the saddles set square on the driving boxes. After spring rigging has been repaired and reapplied, the frames and spring rigging may be painted and the engine is ready for the wheels.

Details That Require Special Attention

If the cylinders do not need renewing they should be bored if out of round 1/16 in., or bushed if they will not true up to 5/8 in. over the correct size. Valve chamber bushings should be bored to 1/8 in. oversize or renewed if already oversize, and packing and bull rings should be carried in stock in these sizes. If slide valves are used the seats should be trued up until they reach 1/8 in. thickness, when they are to be faced flush and false seats applied. Slide valves that have reached 5/8 in. or less in thickness are to be renewed and the pressure plates are to be lined and planed true, so that there will be 1/8 in. clearance when drawn down in place. Guides should be carefully lined, so that the crosshead will be central with the bore of the cylinders and straight bolts fit to a light driving fit and single liners should be applied to hold the guides in place.

When the boiler work is complete, the test made and defective flues replaced, the steam pipes applied and all mountings applied to the boiler, it should be charged with steam or compressed air and the steam passages should be blown out, after which the ports should be examined to locate lodged foreign matter. This done, the steam chests should be closed and the passages to the cylinders blown out by placing the valves in the forward and back positions. The pistons and cylinder heads may now be applied and the stroke of the piston measured, making sure that the piston will have at least 1/2 in. clearance over all.

It is advisable that all work possible, such as the application of air pumps, stacks, sand boxes, bells, generators, cabs, injectors and the like, be handled as early as possible in the erection of the engine in order to avoid the confusion of a large number of men working close together when the engine is nearing completion.

Main reservoirs are due for hammer test at the time when heavy repairs are made, and should be replaced if found defective. A 16-in. reservoir is to be condemned if any part is 3/32 in. or less in thickness, 18 in. to 20 in. reservoirs if 9/64 in. or less and 22 in. and over if 3/16 in. or less, or if any reservoir will not stand 170-lb. hydrostatic pressure.

All brackets or other attachments to the boiler should be left securely fastened in place, special attention being given to these particular parts when the lagging is off the boiler.

Engine truck and trailer trucks should be well built and should have not over 1/4-in. lateral motion when new, the same rule applying to driving wheels.

Planning the Final Operations

After wheels and trucks are applied, shoes and wedges are put in place and the wheels trammed. They will tram if all the work is correctly done, and the wheels should be parallel to lines run parallel to frames, as was done when main centers were laid out. After any errors are corrected, the pedestal braces may be bolted in place and the ash pan, brake rigging and other parts underneath the engine applied.

The motion work should be applied by this time and it should hang free, being without any cramp or strain. The subject of valve setting has been dwelt upon so much that it is not necessary to discuss it here, except to say that this work should be done according to instructions from the proper authority and should not be left to the judgment of the man who does the work. With the valve setting complete and adjustments made, the rods are ready to be applied and adjusted for the proper travel.

With the last details complete, the engine leaves the shop, the tender is coupled and the engine fired up. The pop valves are set, the air brakes adjusted and the engine is run a few revolutions, with the cylinder cocks out to make sure that the cylinders are clean. The engine should make the trial trip with the cylinder and steam chest casings off, the better to locate any leaks that may develop.

In order that all the details necessary to the operation of the erecting shop may be successfully performed, it is necessary that some definite program be adopted. The subject of scheduling or routing deserves serious attention, but the successful operation of the shop depends upon the co-operation of all departments toward that end.

RADIUM.—A recent issue of the Scientific American contains an interesting account of radium. It is stated that so far there are only three or four companies in the world producing radium commercially, and the product of the largest of these is about an ounce a year. The total amount of pure radium in the world today is only about five ounces, the market value being $120,000 a gram, which is one twenty-eighth of an ounce. Only two practical uses have so far been discovered. The first is for medicinal purposes and the second is in the production of the luminous material used on watch and clock dials and as locaters for electric switches, etc. Already more than 4,000,000 watches and clocks have been treated and hardly a third of an ounce of radium has been used in the production of all of the luminous material required. In making this luminous material zinc sulphide or crystallized zinc is used as a base. The glow is caused chiefly by the bombardment of minute particles to which the zinc is subjected in the presence of radium, and it is necessary to have the zinc sulphide of great purity. The largest of the domestic producers has its mines in Paradox valley, Colorado. The ore is hauled to the railroad, a distance of 58 miles, by six-horse wagons, and from there is carried by rail to a plant in Orange, N. J. The reduction process is a complicated one of chemical separation and elimination. After passing through scores of vats, strainers, compressors, evaporators and the like, about eight carloads of ore have been reduced to less than a thimbleful of radium. Considerable quantities of uranium and vanadium are a by-product of the process.

Convention of the Master Boiler Makers

Welding Firebox Sheets; Steam Pressure and Staybolt Breakage; Handholes vs. Washout Plugs

THE twelfth annual convention of the Master Boiler Makers' Association opened at the Curtis Hotel, Minneapolis, Minn., at 10 a. m., Tuesday, May 25. About 250 members were present at the opening session. The opening address was given by Hon. J. E. Meyers, mayor of Minneapolis, who welcomed the association to the city.

Following this William Schlafge, mechanical manager of the Erie Railroad, spoke of the necessity of organization in the industries, in order that productive efficiency might be increased. The duty of all boiler makers, and particularly the foremen, is to hasten the replacement of power equipment in the country by carrying on the good work which has in the past marked their efforts. During the war the principles of conservation of labor and of materials were applied with remarkable results. Machine equipment was adopted wherever possible to aid production; in other words, every effort was made to obtain a maximum result with a minimum expenditure of time and labor. The same principles must be applied to a higher degree now to carry the nation through the present economic crisis without undue hardship. Turning from their constructive duties, Mr. Schlafge spoke of the responsibilities that superintendents and all others in positions of authority have toward the men under them, in instructing them in their work and understanding their requirements. All radical tendencies must be stamped out and the sad experiences of labor in European countries prevented.

The president of the association, John B. Tate, delivered his address on power units of the future. The engineering departments of all roads must provide for more powerful locomotives—engines capable of hauling 150 cars of 150 tons each. In the present freight congestion this need for greater power has been well demonstrated. Stationary boiler design must also be improved, so that the operating efficiency may be increased and the cost of upkeep diminished. Because of the increasing tendency toward the electrification of roads, the size and efficiency of power plant units must be increased. During this reconstruction period the men who hold the responsibilities of supervision in the shops must act at all times in such a manner that decisions are entirely fair and impartial.

The remainder of the Tuesday session was taken up with reports of the secretary and the treasurer and routine business. Under the head of miscellaneous business it was voted to consider the invitation of Section III—Mechanical, American Railroad Association, for the Master Boiler Makers' Association to become a member of the organization.

Wednesday Session

The opening address at the Wednesday session was made by J. M. Hall, assistant chief inspector, Bureau of Locomotive Inspection of the Interstate Commerce Commission, on the causes of boiler failures. Lantern slides of disastrous locomotive explosions were exhibited. The accidents illustrated the more usual contributory causes, and in each case these were quite apparent. Low water, corrosion of plates, bad welding of seams, formation of scale in the water glass and gage cock plugs have all increased the total of locomotive disasters. Mention was made of experiments conducted by the chief inspector's office on the relative accuracy of the gage cock and water glass in indicating the true height of water in a boiler. The conclusion reached, after testing various locomotives in different sections of the country, is that a roll of water is raised at the back flue sheet which the gage cock indicates, while the water glass gives the true level of the water as four to eight inches lower, depending on the size and type of the boiler. Within a short time the bureau will issue instructions on the proper installation of gage cocks and water glasses in relation to each other and to the boiler, in order to overcome the danger from former inaccuracies.

W. H. Bremner, president of the Minneapolis & St. Louis, impressed on the members of the association the necessity for the best workmanship and inspection to keep the present equipment of the railroads at 100 per cent efficiency, for although replacements have been commenced it will be many months before many old locomotives will be eliminated. The railroads depend not on any one individual or group to maintain the standards, but upon every man in the organization, no matter what his duties may be. The same loyalty must be shown to the private companies now as while the roads were under federal control, for the nation's welfare is absolutely dependent on the service of the railroads, which is being well demonstrated at the present time.

After the conclusion of this talk the remainder of the

J. B. Tate (Penn.)
President

C. P. Patrick (Erie)
First Vice-President

Thomas Lewis (L. V.)
Second Vice-President

Wednesday session was devoted to the discussion of papers submitted by members of the association.

Relative Advantages of Handhole Plates and Washout Plugs

In the absence of a report from the entire committee on this subject, the secretary read the personal report of Charles P. Patrick, chairman of the committee.

The question as understood means, what is the best washout opening device to tighten under pressure? This question involves other considerations which must be met. Accidents, expense and terminal delays to locomotives are to be considered with the subject.

The best device to overcome leakage when the boiler is under pressure is a good-order brass plug having 12 threads to the inch and a taper of ¾ in. to the foot. These plugs must be full in size, made of good material and have four full, good-order continuous threads at least in the sheet. If these conditions are maintained there will be but little chance of material leakage, and if leakages occur there is little or no trouble or danger in tightening a good-order plug properly applied, which has from some cause or other not been made tight while the boiler was empty.

We cannot provide against neglect of sheets or plugs which cause failures and accidents. These conditions are controlled by the boiler inspectors and men in charge of the work. If the threads on a plug are bad, or the plug allowed to be used plug. As to accidents chargeable to these plugs we have the following record from the Bureau of Locomotive Inspection:

"We have 69,000 locomotives coming under this department. During preceding years the accidents from arch tube and washout plugs consisted of

13 in 1912	17 in 1916
20 in 1913	8 in 1917
21 in 1914	14 in 1918
16 in 1915	30 in 1919

making a total of 139 accidents from all causes during the last eight years, or an average of 17.3 per year. We will assume 18 accidents per year.

"About 40 per cent of these locomotives, or 27,600, are equipped with arch tubes, and the average number of plugs in each boiler is 25. For the entire lot of engines this gives 690,000 plugs. The remaining 41,400 locomotives are without arch tube plugs; therefore have eight less, or 17 plugs per boiler, giving a total of 703,800 plugs, and a grand total of 1,393,800 plugs.

"Some water conditions necessitate the removal of plugs only once a month, while the other extreme is reached in bad water districts where as many as 10 removals a month are made. However, to be on the safe side we will take an average of two washouts a month, which means 33,451,200 washout plugs removed each year. As before stated, we have an average of 18 accidents per year, or one accident for every 1,858,177 plugs removed.

T. P. Madden (Mo. Pa.)
Third Vice-President

E. W. Young (C. M. & St. P.)
Fourth Vice-President

H. D. Vought
Secretary

after it gets a shoulder by which it is temporarily frozen tight, or the sheet allowed to grow thin to the extent that it does not contain sufficient threads to hold the plug, or the threads bruised and battered so a plug will not tighten, an accident or engine failure may occur.

Also the brass screwed washout plug is the most economical washout opening device in use today, and there are no other removable attachments to the boiler that give less trouble or cause fewer accidents.

Discussion

Although handhole plates have been used in some cases without undue trouble, it seemed to be the consensus of opinion that a plug of good design made of brass or steel is far superior, and most of the roads in the country eliminated handhole plates many years ago. All members agreed on the standard of 12 threads per inch, but the taper used varied from ¾ in. to 1¼ in. per foot, the results, however, differing but slightly. It is possible that plugs having the greater taper are less liable to have a shoulder form, which shortens their period of usefulness.

There are no more complete data on a locomotive device in the records of the bureau than on the service of the washout

"There is really no reason whatever to be alarmed about accidents from washout plugs. They are the safest device I know of on a locomotive boiler, considering how often they are handled.

"And it is also, in my opinion, the cheapest device for stopping up a hole in a boiler which has to be unstopped and restopped from one to ten times a month."

Tensile Strength of Firebox Steel

On the question of whether the best results may be obtained from firebox steel having a tensile strength from 48,000 to 58,000 lb. per sq. in., or from 55,000 to 65,000 lb. per sq. in., the committee has endeavored to make the report on the subject as brief as possible. In gathering this information we find there is a very slight difference of opinion, or rather a slight difference in the specifications of the various railroads, for firebox steel.

The members of the committee have given considerable attention to the care of locomotive boilers, including the study of failures of firebox sheets.

In general, firebox sheets fail in one of two ways:

(1) Gradual Failure: The sheet may have a good many

small cracks, which are mostly in a vertical direction. These cracks are thickest, radiating out from the staybolts and frequently run from one staybolt to another in the same vertical row, but never between staybolts horizontally. These cracks are almost always on the fire side and at times extend through the thickness of the sheet, first going through next to the staybolts. Such sheets are almost always accompanied with more or less corrugation, and the cracked and corrugated condition is almost always confined to the lower half of the sheet.

(2) Sudden Failure or Rupture: The sheets may fail by a single crack or rupture from a foot to several feet long. In bad cases the crack may extend from the mud ring to the crown sheets, but ordinarily the cracks are confined to the lower half of the sheet, extending upward from the mud ring or from a few inches above it, and it is always near the middle of the side sheet longitudinally. Such sheets may show no corrugations and may show very little if any other defects.

The failures of the first kind are of gradual formation, but those of the second class occur suddenly.

The records on file of one of the largest railroads in the United States show that between the years 1886 and 1913, 115,000 tons of boiler and firebox steel were used on locomotive boilers, and they do not have any record of any failure that resulted in injury to persons or loss of life due to the character of the material.

This same railroad in 1892 specified and adopted firebox steel with a tensile strength of 55,000 to 65,000 lb. per sq. in., and they are using the same grade today.

It is the opinion of the committee that the life of the firebox sheets does not entirely depend on the specifications or tensile strength of the material, but rather on the care and treatment to which the plates are subject; for instance, the washing of boilers with cold water before the boiler is properly cooled down; second, using the injectors when active steam production is not going on.

In conclusion, from the best information this committee was able to obtain, firebox steel with a tensile strength of 55,000 to 65,000 lb. per sq. in. gives the best results.

However, we would also add that it is our experience that by suitable treatment of water supplies, a proper arrangement for delivering feedwater into the boilers and proper methods of caring for boilers in the enginehouses and elsewhere, long life can be expected with most any grade of firebox steel.

The report is signed by W. J. Murphy, chairman; J. F. Ferestrum and Lewis Eberle.

Discussion

Opinion seemed about equally divided on the desirable tensile strength for firebox steel. Good results have been obtained with steel from 48,000 to 58,000 lb. per square inch, as well as from the higher strength of 55,000 to 65,000 lb. per square inch. It seems to be true that if the staybolts are properly applied along the fire line, crown sheet failures will be prevented. In any case the strength of steel or the carbon content have little to do with failures so long as the material is within the 48,000 to 65,000 lb. per square inch limit.

Effect of Steam Pressures on Staybolt Breakage

On the subject of superheating and reducing steam pressures in locomotive boilers and their effect on staybolt breakage, the committee submitted the following report:

The compiled data taken from six different territories or districts where the service, water condition, etc., differ largely and steam pressure is about the same, are given.

The chart shows there is no doubt that the superheater and reduction of steam pressure of boilers from 220 to 195 lb. pressure will decrease the staybolt breakage.

We have also compared 10 locomotives previously operated as saturated without brick arch. These locomotives were later equipped with a superheater and brick arch, and the pressure remained the same—205 lb.

The comparison shows considerably less staybolt breakage. (While this paper is not on the brick arch, we consider they are co-related and have some bearing on the subject.) The reduced breakage of staybolts is accounted for along these lines: The brick arch acts as an indicator, making the proper handling of the boiler compulsory. If the boiler is blown down too soon arch tubes will be distorted. Saving the arch tubes also saves the staybolts.

DATA ON STAYBOLT BREAKAGE COVERING PERIOD OF FIVE YEARS

District number	Number of locos.	Steam pressure	Total broken	Bolts broken per year	Bolts broken per engine per year
Superheater..........	5	185 to 200	127	25.4	5.08
Saturated............	5	220	514	102.8	20.56
Superheater..........	5	185 to 195	216	43.2	8.64
Saturated............	5	220	710	142	28.4
Superheater..........	5	185 to 200	1,193	238.6	47.72
Saturated............	5	220	1,848	269.6	73.9
Superheater..........	5	185 to 200	196	39.2	7.84
Saturated............	5	220	1,610	322	64.4
Superheater..........	5	185	432	86.4	17.28
Saturated............	5	220	470	94	18.8
Superheater..........	1	185 to 200	71		
Saturated............	5	220	358	71.6	14.32

All engines involved are Pacific type.

Our records show that superheating and reducing of steam pressure of boilers result in a reduction of staybolt breakage.

The report is signed by T. L. Mallam, chairman; F. A. Mayer and E. J. Sweeney.

Discussion

An individual report on this subject was submitted by T. L. Mallam, chairman of the report committee.

"The New York Central Railroad, in connection with the Pennsylvania, during 1910 made two elaborate series of tests, and the results obtained showed that superheater locomotives decreased the demand on the boiler from 25 to 35 per cent; that is to say, the boilers of the superheater locomotives have to make considerably less steam than the boilers of the other type. This is, of course, due to the fact that less superheated steam, with its greater heat content, is needed for a given power.

"In line with the results of these tests and my own experience, I contend that superheated boilers do not break as many bolts as boilers not superheated. We have in service on our road four O. G. style fireboxes that are not superheated. These four engines carry 200-lb. per square inch pressure, whereas all the others carry 180-lb. pressure. We find that more staybolts are broken in these four engines than in any eight superheaters.

"There is a question in my mind whether the lesser staybolt breakage on our superheaters is the result of the lower boiler pressure or whether it is the result of other conditions caused by superheat, design and service. As just mentioned, I think the superheater boilers do not have to make as much steam as the saturated steam boilers and therefore do not have to be worked as hard as the latter, with the result that firebox sheets are not punished as badly. The lower boiler pressures of a superheater may help, but I am of the opinion that the greater advantage to staybolts and boiler maintenance conditions from superheat is that with it an engine can be more easily fired and the steam maintained more uniformly.

"I believe everyone appreciates the fact that staybolts are caused to break by expansion and contraction, which again causes the inside and outside sheets to move with relation to each other. The harder and more irregularly the boiler is forced, the greater will be such movement and the greater the staybolt strain. The lower the factor of safety in the design, the greater becomes the chance for staybolt breakage with this strain."

The early part of the discussion seemed to indicate that

the mere act of decreasing the steam pressure by superheating to obtain the same power as with saturated steam would decrease the breakage of staybolts. However, the problem is not quite as simple, for staybolt breakage depends on a variety of independent factors. The steam must, of course, be considered, but so also must the type of service, the general topography of the country in which an engine operates, the quality of the water used, and above all the state of repair of the locomotive. To gain even an approximate comparison between superheated locomotives and those utilizing saturated steam, engines of the same type in the same sort of service and the same condition of repair must be used. The nearest approach to such a comparison came from a representative of the Georgia Railroad, in whose charge are eight locomotives fulfilling the above conditions, four of which are superheaters and the other four use saturated steam. From accurate records of the staybolt breakage on these eight machines there does not seem to be a bit of difference. The final conclusion reached is that the design of a locomotive and its service and care have all to do with staybolt breakage.

Cinder Hopper on Bottom of Smoke Arch

From inquiries and observations made, the committee finds that the use of a cinder hopper on the bottom of the smoke arch is quite varied. There are roads that have some of their engines equipped with a hopper, and others not so equipped, and their performance is also varied; some engines with the hopper as well as those without it clean themselves satisfactorily and steam well, while other engines of the same class and type, having the same design and adjustment of front-end appliance set alike, do not perform as well, accumulating such an amount of cinders in the front end that it is necessary to clean them out while on the road and away from the terminal.

The committee is aware of the fact that with some grades of coal the front end fills up to a greater extent than with other kinds, and to facilitate the removal of cinders the hopper is a convenience, if not a necessity. However, its use or non-use depends largely on local conditions, kind of fuel and grade of coal used. We incline to the opinion that it is not necessary to maintain the hopper on oil-burning nor on coal-burning engines that have front-end draft appliances so designed, fitted and adjusted that they will clean themselves without danger of throwing sparks of such size and glow that they cause fires on the road.

Our inquiries further indicate that the foregoing also applies equally as well to the second part of the subject, "On what size locomotives should it be maintained?" and that the use of the cinder hopper is about evenly divided between the larger and smaller classes of engines on the various railroads.

In regard to the third question of the subject, viz., "Which is the better design to overcome air leaks?" we find that there are a number of different designs used by the various roads. Some have hoppers with a double nozzle lengthwise of the smoke arch, others a double nozzle transverse with the arch, the cover held in place by a bolt and spring between the nozzle, while on others a single nozzle with the cover hinged so it will drop down, or one that opens to one side, is used. Again, others have the single nozzle hopper, the cover being of wedge shape. As it is of great importance to keep the front end as free as possible from air leaks, it is our opinion that the single nozzle hopper with the cover plate fastened on each side is a better design.

The report is signed by Frank H. Davison, chairman. Thomas J. Reddy and John L. Welk.

Discussion

The need of the cinder hopper on the bottom of the smoke arch has long since been eliminated by most roads. In its place a standard form of non-adjustable, self-cleaning front end has been applied. In some instances a patch is riveted under the smoke arch and a two-inch washout plug arranged to take care of any leakage from the pipes or superheater tubes.

Flanging of Firebox Sheets on the Flange Press

The committee reported that the flanging of firebox sheets on a flanging press is not detrimental. It is a matter of the proper heating of the material.

Cold flanging can be successfully employed on round heads and straight sides of flue and door sheets in all types of fireboxes.

The report is signed by Robert C. Gibson, chairman.

Thursday Session

A short talk was given by A. H. Kipp, mechanical superintendent of the Soo Line, on the duties of the members of the association to the country. Following this the discussion of papers was resumed.

Electric and Oxy-Acetylene Welding of Firebox Sheets

In the absence of a report, Prof. A. S. Kinsey, in charge of welding and shop practice at Stevens Institute of Technology, gave a general survey of the present standing of autogenous welding and the future prospects of its recognition as a permissible process of boiler construction.

Professor Kinsey had just been present at the St. Louis meeting of the American Society of Mechanical Engineers, at which a prominent insurance company requested that the Boiler Code Committee, of which Professor Kinsey is a member, allow the use of autogenous welding in stationary heating boilers generating steam up to 15-lb. pressure. The Boiler Code Committee is considering this petition seriously and will probably report favorably on it. In connection with this subject the A. S. M. E. Boiler Code Committee has appointed a sub-committee to investigate the matter of welding seams in boilers and pressure vessels with a similar committee from the American Welding Society.

Forge welding has been allowed a rating of 52 per cent, or a permissible load of 52 per cent of the strength of the metal, by insurance companies. Although autogenous welding is not recognized as yet, there is no reason why fusion welding cannot be made very nearly as strong as forge welding. As a matter of fact, an increase in the rating of forge welding from 52 to 75 per cent is now being considered by the A. S. M. E. If every one interested in advancing the process is united, first of all, in demanding the best welds possible in the shops where the process is used and then in advocating its adoption and recognition by the insurance companies and the A. S. M. E., there can be little doubt of the outcome.

From consultations with A. G. Pack, chief inspector of the Bureau of Locomotive Inspection, and from extensive examinations of defective welds taken from exploded boilers, Professor Kinsey stated that they were some of the worst welds he had ever examined and that they had done a great deal to retard the advance of the process.

The development of autogenous or better fusion welding has nearly reached the point where it is possible to weld manganese steel frogs on rails. Firebox plates can be welded as safely as they can be riveted by either the electric arc or acetylene torch. Any weld may be easily made to lose its strength by burning or oxidizing the metal, and this is the greatest defect to be combated in the operation of welding.

Two rules should be followed in welding. The grain of the metal should be so refined as to come back to its original size and, in the case of steel, the weld should be annealed. When recognized by the A. S. M. E., this requirement for annealing will probably be inserted in the rules for permissible welding procedure.

At the St. Louis meeting of the A. S. M. E. the safe-ending of boiler tubes was discussed at one of the Boiler Code Committee sessions, and the records were consulted to determine

if welding were allowable in this case. It was found that it is permissible to weld the safe ends of tubes in fire tube boilers but not in water tubes, which means that locomotives may use it in this connection.

Discussion

The criticisms brought out at the last convention have served their purpose in arousing the interest of all members of the association, and no doubt the fewer accidents from the letting go of welded seams may be due to the closer supervision of all welding in railroad shops. However, if the reports of the Bureau of Locomotive Inspection continue to show any disastrous explosions from the failure of welded seams, it will be a difficult matter to obtain an early official recognition of the process.

A short paper on the procedure used in electric arc welding was given by one of the members.

On the Santa Fe the welding departments of all shops are required to send test specimens of their work to the laboratories to be tested to destruction. The seams are reinforced about 20 per cent and when pulled average about 83 per cent, which is about what is obtained with riveted joints. One instance was cited of 29 specimens taken out of plates after being in service 4½ years, which tested 71 per cent.

As on all other questions, opinion was divided. Certain members advocated great caution in adopting the process, particularly where human life depends on the quality of the work. So long as there is a doubt as to the safety of a seam, and certainly until disasters from weak seams have stopped, it is well to avoid the extensive application of autogenous welding. The discussion turned from welded seams to the welding of flues. In certain sections of the country it was found that electrically welded superheater flues cracked, while smaller tubes were not found to do this. In still other districts leaks are found in both superheater and smaller flues. In bad water districts, scale forms in pockets around the flue end, and by preventing the cooling effect of the water, permits the heat to crack the tube. This applies to the side sheet, under the arch as well as where the heat is intense. When staybolts are calked where they enter the side sheets, pin cracks are started if the water does not circulate properly. Flues should be prossered in bad water districts.

Where welds have been found sound in good water districts, a few months with hard water have only been necessary to allow the formation of cracks. The conclusion seemed to be that in good water districts welded flues remained tight, while bad water tended to hasten the formation of cracks in safe ends.

The subject of welded patches was barely touched upon without any definite decision as to their use.

Best Style Grate for Bituminous Coal

No report was submitted by the committee, but a brief outline of the use of the box grate was presented by William Stinsky. In the course of the discussion it was stated that the time is rapidly approaching when the dump grate will be eliminated from both ends of the firebox. The best results have been obtained with box grates having a width of nine inches. If a dump grate is used it must be kept from under the flues, for if used in this position all sorts of leakage and trouble result.

The draft opening in the ashpan was brought up for discussion, and the opinion seemed to be general that at least 15 per cent of the grate area should be opened in the pan to obtain complete combustion of fuel. Even with the opening in the pan, sufficient flues must be installed to carry off the gases. Side openings and center openings have been tried, and netting has been used in the pan, all bringing about good results where used to fill certain operating requirements.

Box grates up to 11 in. wide have been tried and minimum openings of 18 per cent, with varying degrees of success. The standard, however, seems to be a nine-inch grate and a 15 per cent ashpan opening.

Following this the annual election of officers was held.

Officers for 1920-1921

President, Charles P. Patrick, Wilson Welding Repair Company; first vice-president, Thomas Lewis, Lehigh Valley; second vice-president, T. P. Madden, Missouri Pacific; third vice-president, E. W. Young, Chicago, Milwaukee & St. Paul; fourth vice-president, Frank Gray, Chicago & Alton; fifth vice-president, Thomas F. Powers, Chicago & North Western; secretary, Harry D. Vought; treasurer, W. H. Laugbridge, Hocking Valley.

Executive board for one year: L. M. Stewart, Atlantic Coast Line; John F. Raps, Illinois Central; John Harthill, New York Central. For two years: W. J. Murphy, Pennsylvania Railroad; Harry F. Weldin, Pennsylvania Railroad; E. J. Reardon, Interstate Commerce Commission. Three years: B. F. Sarver, Pennsylvania Lines; George Austin, Santa Fe; H. J. Wandberg, Chicago, Milwaukee & St. Paul.

DRILLING RECORDS MADE AT ATLANTIC CITY

Drilling demonstrations with Cleveland milled high speed drills were conducted during the annual June convention of the American Railroad Association, Sections III and VI, at Atlantic City. Several records were made in these tests and it is reported that records made in 1911 were completely shattered. On June 15 and 16, milled high speed drills were forced through cast iron at the rate of 6 ft. per minute and through machinery steel at the rate of 2½ ft. per minute. Details of speed, feed, etc., are given below.

Material	Dia. of drill	R.p.m.	Feed in. per rev.	Number of inches drilled	Vol. lb. removed
3 in. cast iron.........	1 in.	720	.100	9 in.	14.74
3 in. mchy. steel.......	1 in.	600	.050	3 in.	6.60
3 in. cast iron.........	1¼ in.	720	.100	15 in.	23.01
3 in. mchy. steel.......	1¼ in.	500	.040	3 in.	7.00

It is evident that the above records could not be recommended for commercial shop practice as few, if any, shops would have the press equipment or power to duplicate them. For example, in making the record in cast iron with a 1-in. drill, a feed of .100 in. per revolution and speed of 720 R. P. M. were used. Good shop practice would indicate a speed no greater than 267 R. P. M. and a feed of .015 in. per revolution. In the tests shown above, both the feed and speed exceeded normal practice. The same statement applies to the record in machinery steel. Demonstrations, like the above, show the tremendous reserve in the modern high speed milled twist drill. Stock drills were used in the tests and the drills were driven by a Foote-Burt heavy duty drill press.

Additional drilling tests were conducted in open hearth chrome nickel steel using Hercules high speed drills made by the Whitman & Barnes Manufacturing Company, the power being furnished by a 6 ft. American radial drill. The results of these tests showed conclusively that hard and tough alloy steels can be drilled on a production basis and economically. The chemical analysis of the steel showed .50 per cent carbon, .90 per cent chromium, 1.00 per cent nickel and .75 per cent manganese. Holes 3 in. deep were drilled in nine seconds with 1 in., 1⅛ in. and 1¼ in. drills attaining a penetration of 1 in. every three seconds. The following is a summary of the data secured in these tests:

Material	Dia. of drill	R. p. m.	Feed in. per rev.	Time per hole	Average No. holes per grinding
3 in. alloy steel..	1 in.	500	.040 in.	9 sec.	32
3 in. alloy steel..	1⅛ in.	500	.040 in.	9 sec.	24
3 in. alloy steel..	1¼ in.	500	.040 in.	9 sec.	27
3 in. alloy steel..	1½ in.	500	.029 in.	12½ sec.	29
3 in. alloy steel..	2 in.	206	.040 in.	22 sec.	27
3 in. alloy steel..	2½ in.	206	.022 in.	40 sec.	12

Right Line Radial Drilling Machine

RIGHT line radial drilling machines built in either full universal or plain types and with five-foot or six-foot swing have been developed and placed on the market recently by the Niles-Bement-Pond Company, New York. These right line radials embody somewhat radical changes from the usual type of radial drill. The drive has been simplified so that a high percentage of the driving power is delivered to the spindle. A general view of the machine, Fig. 1, indicates the entire absence of belts and the reduction of driving gears to a minimum. A feature of the new drill which adds to the rigidity of the machine and simplicity of drive is the patented double column arrangement, a cross section of which is shown in Fig. 2. This arrangement allows for direct drive from the motor to the spindle through the double column also shown in Fig. 3. The column is a single casting formed of two box section members cast integral at the top and bottom, the arm saddle being mounted between them. The motor is mounted on the back of the arm saddle and drives the spindle through a single horizontal shaft running between the column members.

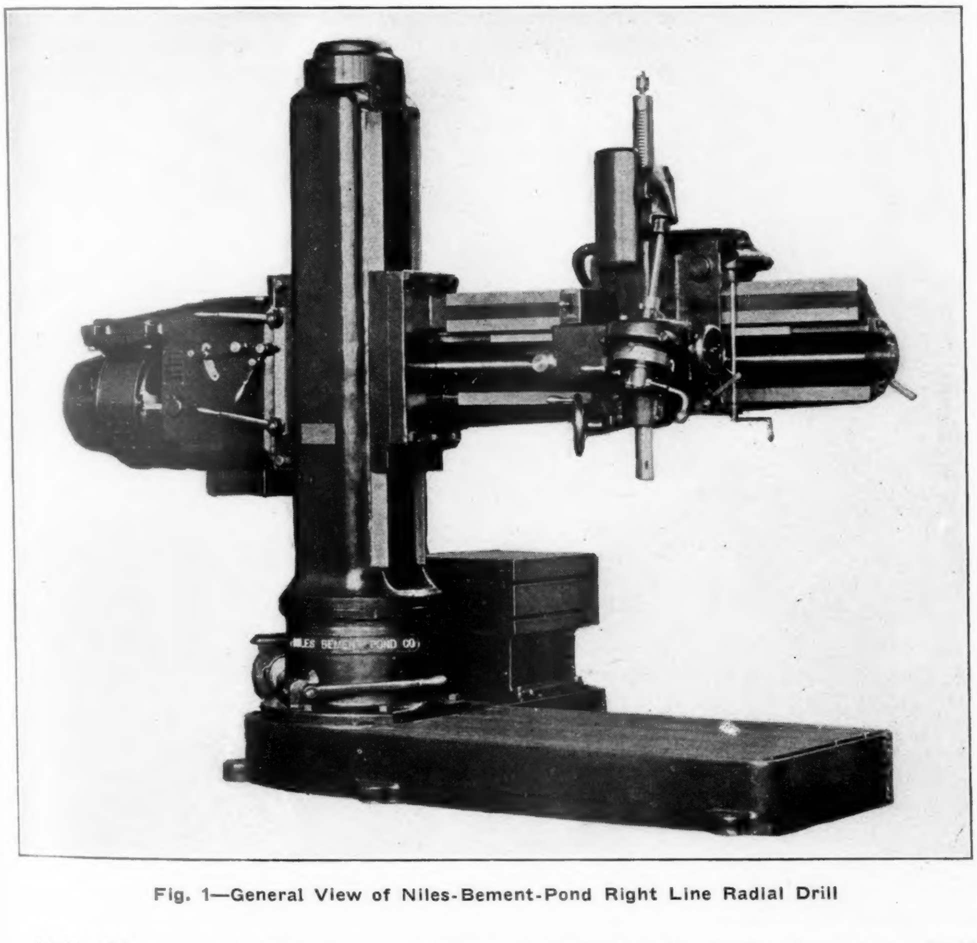


Fig. 1—General View of Niles-Bement-Pond Right Line Radial Drill

Since the column is not stationary, but rotates with the arm, it has been possible to place the metal to the best advantage in the form of a patented beam section. Bending stresses in the column are always in the direction for which this section is designed. Another advantage of this type of column is that it permits the use of vee tracks at the front and back for guiding the arm saddle. When clamped by means of a wedge connection on these tracks, the arm and column form a rigid unit. Instantaneous clamping of the column to the pedestal is obtained by means of a motor operated device shown in Fig. 4. This device is both simple and convenient in operation and the clamp is engaged and disengaged by throwing a switch located on the control head. It is not necessary for the operator to leave his working position. A lever for clamping by hand also is provided. The electric clamp is operated by a small motor with one wheel, the mechanism being self-adjusting. The arm is especially easy to swing, its entire weight being supported on a ball bearing at the bottom of the column. When clamped, a broad metal to metal contact makes the column and pedestal practically one piece.

The maximum resistance to drilling pressure is secured by a specially designed arm cross section as shown in Fig. 5. With the upper narrow guide for the saddle and the lower bearing set in a plane back of the front surface, the driving shaft is brought closer to the spindle and a greater depth is secured from the front to the back of the arm. Under heavy drilling strains, this design tends to eliminate the deflection of the column and arm structure.

The arm is raised and lowered by power from the driving motor, the mechanism being engaged by throwing the clutch lever located on the driving gear box. The machine is started

and stopped by means of a controller handle on the control head. The elevating and clamping mechanisms are interlocking and cannot be engaged simultaneously with resultant damage to the machine. An automatic stop to pre-

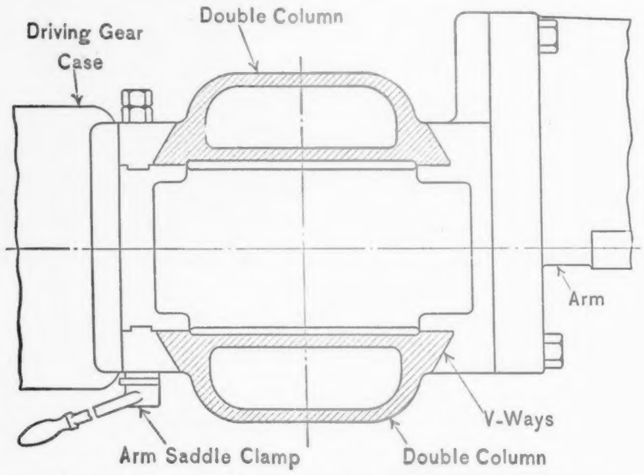


Fig. 2—Cross Section of Double Column Arrangement

vent damage or accident to the machine should the operator carelessly run the arm to the limit of its travel in either direction has been provided. This device also stops the arm in case an obstruction is met in lowering. The elevating

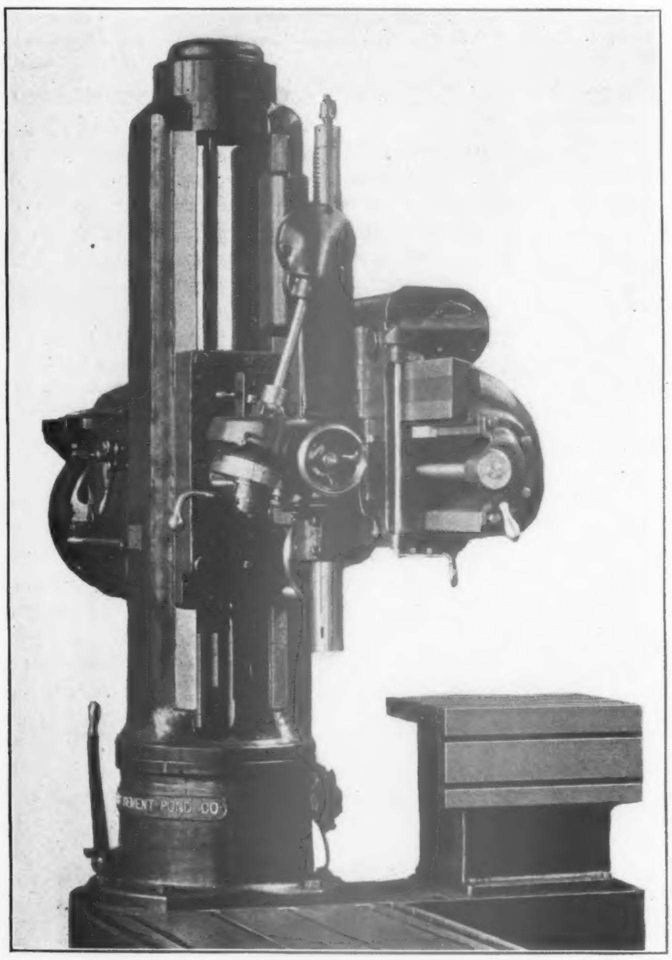


Fig. 3—The Main Driving Shaft Passes Between the Two Columns

screw is hung at the top of the column on a friction ring and when the spindle or arm meets an obstruction in lowering, the elevating screw is lifted and turns freely, thus stopping the arm.

Only four driving gears and one double faced pinion are used between the motor and spindle and the driving mechanism has been further simplified by eliminating friction clutches for spindle reverse and tapping operations. The spindle is quickly and accurately reversed by reversing the

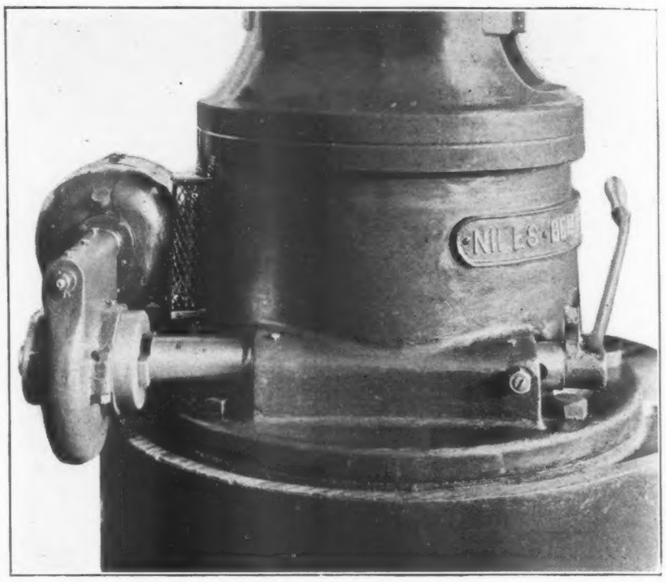


Fig. 4—View of Electric Column Clamp

motor through the controller lever. The spindle counterweight is geared to the spindle and supported at its center of gravity to eliminate friction. A depth gage with an automatic feed trip is provided for drilling to a desired depth. Rapid hand traverse of the spindle is secured by means of

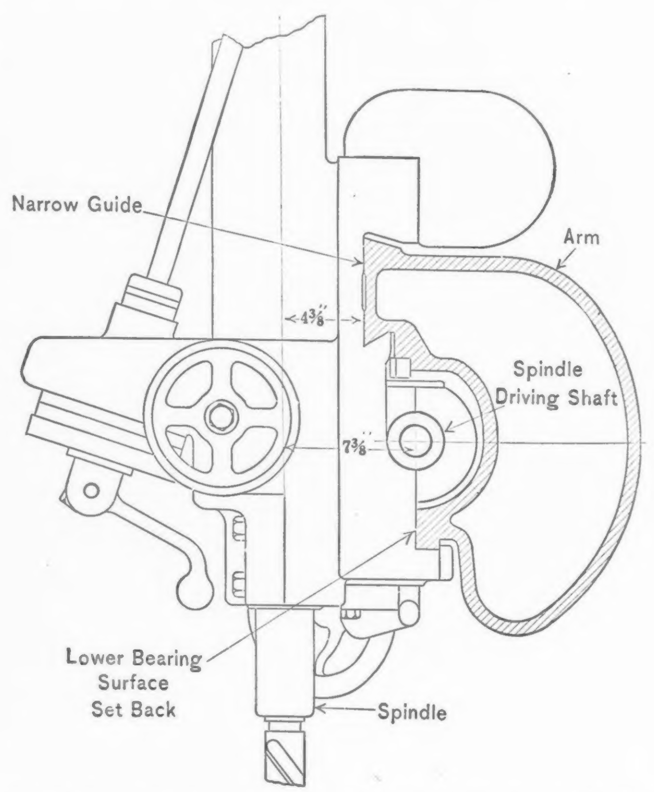


Fig. 5—Cross Section of Arm Designed for Maximum Torsional Strength

a lever which, when pulled down, engages the power feed.

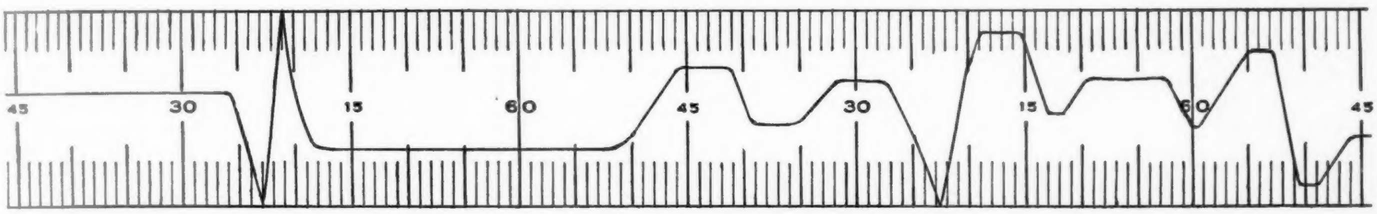
An ample range of speeds is provided and there are eight positive geared feeds changed by means of a graduated disc.

Fine hand feed for the spindle also is provided. The drill head is easily moved along the arm by means of a hand wheel conveniently located at the front of the head. On universal machines, this hand wheel can be swung back out of the way when the spindle is to be swiveled.

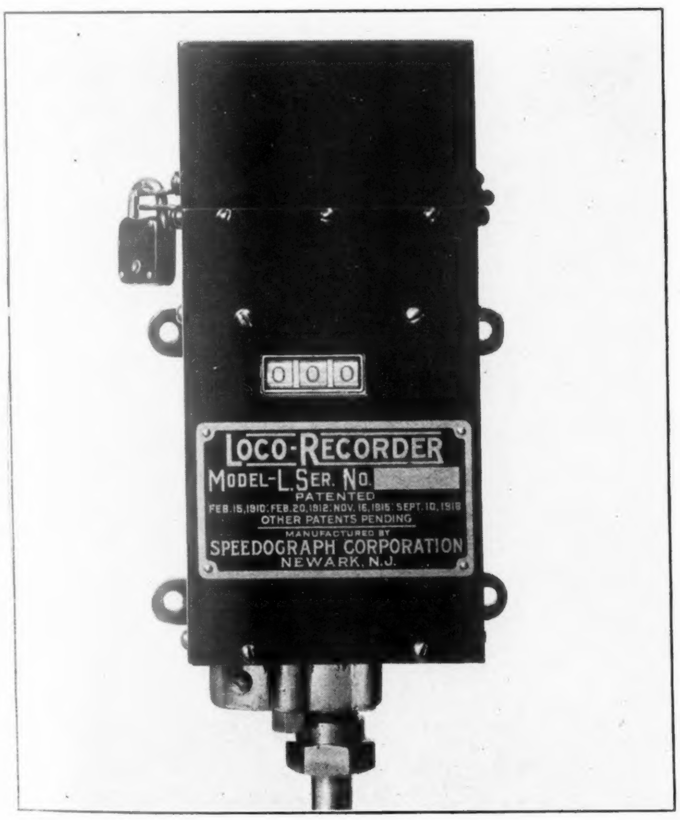
For direct current drive, a 10 hp., four to one variable speed motor is required. For alternating current drive, a gear box is included to give the additional speeds required. In either case, the motor is provided with an automatic brake for stopping quickly in tapping operations.

Recording Instruments for Switchers

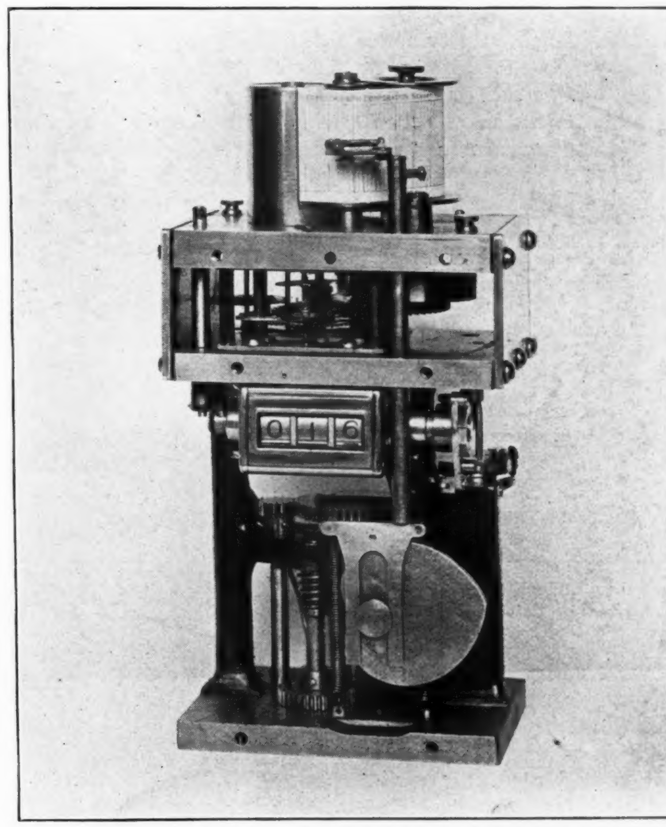
A DESCRIPTION of a model *K* recording instrument for locomotives in road service was given on page 306 of the May *Railway Mechanical Engineer* and the model *L* Loco-Recorder, described in this article, is designed for use on switchers. The instrument furnishes a clear and complete performance record of switch engines, and affords information, the vital importance of which has long been appreciated. The record shows: (1) The time in hours and minutes that the engine is idle; (2) the time in hours and minutes that the engine is working; (3) the distance in miles actually covered; (4) the speed at which the engine is operated at any point or at any time.



Record of Switchers for Four Hours Reading from Right to Left



A Locked Metallic Case Prevents Tampering With the Mechanism



Internal Mechanism of the Loco-Recorder

An odometer automatically records the exact mileage, registering every 35 ft. and can be set back to zero at the end of every day, week or month as desired. To conform to the service required of it, the recorder operates on a time basis. The recording tape, which is calibrated in minutes, is drawn past the pencil at the rate of four inches to the hour. The pencil moves up and down when the engine is in motion, the distance across the tape, 1-3/16 in. in length, representing one-half mile traveled. The angle of these lines and their relation to the minute marks show the rate of speed. Broken lines indicate reverses.

When the engine is idle the pencil remains stationary and makes a straight horizontal line on the tape. The total idle time is thus easily calculated. An actual reproduction of the record of a switch engine for four hours, is shown in the illustration. This record shows that the switcher went ahead an eighth of a mile, stood still for two minutes, reversed and ran three-eighths of a mile at a speed of nearly eight miles an hour. It then stood still for

two minutes, reversed and ran a quarter of a mile in five minutes, reversed again and ran an eighth of a mile, stood still for seven minutes, reversed again and ran 150 yards, reversed again after standing a little more than a minute and ran a quarter of a mile in two minutes and a half. After standing for four minutes the engine again reversed and ran three-quarters of a mile in eight minutes. It then made three short runs and three reverses, with three stops of about four minutes each, and was idle for 27 minutes, after which it ran a mile and an eighth at a maximum speed of half a mile in two minutes and was idle for 20 minutes. Knowledge of yard conditions makes the record a complete story of the day's work, down to the smallest detail, and it is an easy matter to compute the idle, and working time and the service performed.

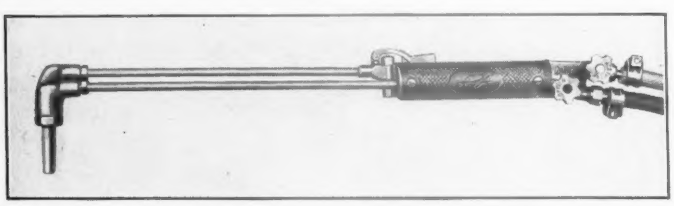
Since speed indications on a switcher are not required, the instrument can be attached to any convenient part of the locomotive and is not necessarily placed in the cab. The water-tight cover, which has to be raised for the removal and insertion of tapes, is securely locked, as shown in the illustration, and this prevents any interference with the recording mechanism. Loco-Recorders for both switchers and road locomotives are manufactured by the Speedograph Corporation, Newark, N. J.

Cutting and Welding Torch for Shop Use

CERTAIN inherent characteristics should be possessed by cutting and welding torches intended for shop service. Among these characteristics may be mentioned simplicity, ruggedness, low cost of maintenance and safety in operation. In addition, the torch should be light, well balanced and economical. With the desirability and importance of these characteristics well in mind, the A. G. A. Railway Light & Signal Company, Elizabeth, New Jersey, has recently developed a line of oxy-acetylene cutting and welding torches known as the A. G. A. torches. These torches have been thoroughly tested under severe service conditions in railway shops, navy yards and other industrial plants and are reported to have given uniformly satisfactory service.

Mixture of the gases is accomplished in the tips which are of the one piece type, thus eliminating the possibility of losing either the tip or mixer parts. The high pressure valve of the cutting torch is operated by the thumb in such a way that a single motion will open or close it. This makes alterations in pressure possible with a minimum loss of time. A welding table is furnished with the torches, and reference to the line showing thickness of metal in sixteenths of an inch, will indicate the number of tip to be used; also, the proper gas and oxygen pressures.

The standard manufacturer's torch of this make weighs only 28 ounces and is not tiresome to hold. It has been demonstrated that the effect of a heavy torch on the quality and quantity of an operator's work is most important. Not only is it necessary that a torch be light in weight, but it must be well balanced in order not to cause unnecessary fatigue to the operator. With hoses attached, the A. G. A. torches balance at a point in the center of the grip. The grips are made of a ventilated, non-conducting material, oval in cross section and therefore easy to control.

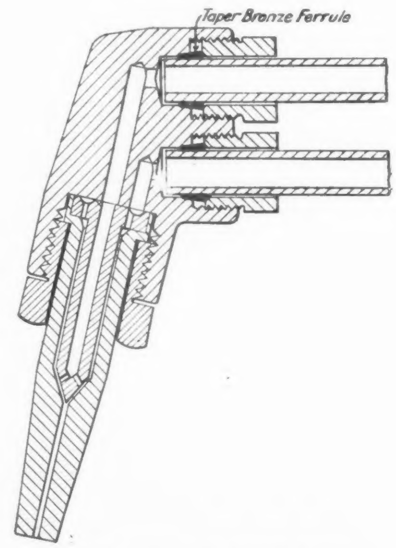


A. G. A. Cutting and Welding Torch

Gas connections are indicated by distinctive colors as advocated by the Bureau of Construction and Repair of the Navy Department, the valve handles being plainly marked "Oxygen" and "Acetylene." All inflammable gas cylinders are painted red and the oxygen cylinders, black. This color scheme being carried out in the hoses, there is little danger of wrong connections and accidental explosions.

While not intended to be abused, torches are often subjected to rough usage either through accident or carelessness. The torches, illustrated, are of rugged construction and the tips, being internally threaded, are protected against damage. The heads and valve bodies are made of drop forged bronze to insure durability, the gas head tubes being of seamless drawn brass, which is difficult to spring. Nuts on which there is a considerable amount of wear are made of phosphorous brass.

Low cost of maintenance is secured by making the torches of interchangeable parts, assembled with mechanical metal to metal joints. There are no brass, soldered or welded joints to be made. Referring to the view showing a cross section of the torch head, it will be evident that the gas head tubes are tightened in the valve body by taper bronze ferrules forced tightly about the tubes by the hexagon head nuts. The torches can be completely disassembled by the operator and then reassembled without difficulty; hence, a damaged part does not necessitate factory repairs or scrapping.



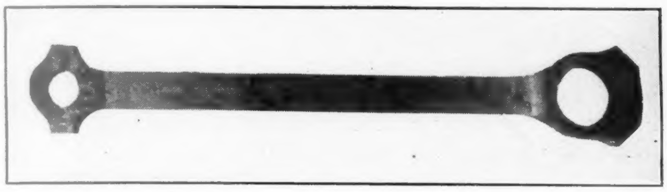
Cross Section of Torch Head

Economy of gas consumption can be secured only by establishing and maintaining a true neutral flame. Either an oxidizing or carbonizing flame indicates an excess of free oxygen or acetylene, respectively, damaging the quality of the welds and causing uneconomical torch welds. Complete mixing is accomplished in these torches by forcing the oxygen and acetylene together at equal pressures, passing the mixture through a restricted conical orifice which sets up a turbulent effect in the stream of gas and at the same time creating a velocity which prohibits back flash. The mixed gases emerge from this orifice and proceed down the tip, the turbulent effect decreasing as the mixture becomes more

and more thorough. It is not possible to thoroughly mix gases by allowing them to run together. They must be forced together and agitated until the mixing is completed. A glance at the cross sectional view will indicate how this thorough mixing is accomplished in A. G. A. torches. Economy in gas consumption, freedom from back fire and elimination of the possibility of self-destruction, by internal burning, are secured by the design of these torches.

Facilitating the Removal of Side Rods

BY MAKING both main and side rods, also link motion rods, symmetrical above and below the true central plane, a method was described on page 105 of the February, 1917, *Railway Mechanical Engineer,* which makes it possible to get along with a much smaller stock of rods. The idea is to make the rod with two oil cups, one on each side, and by this construction, the rod can be used on either side of the locomotive, thereby reducing the number of rods required to be carried in stock by one-half.



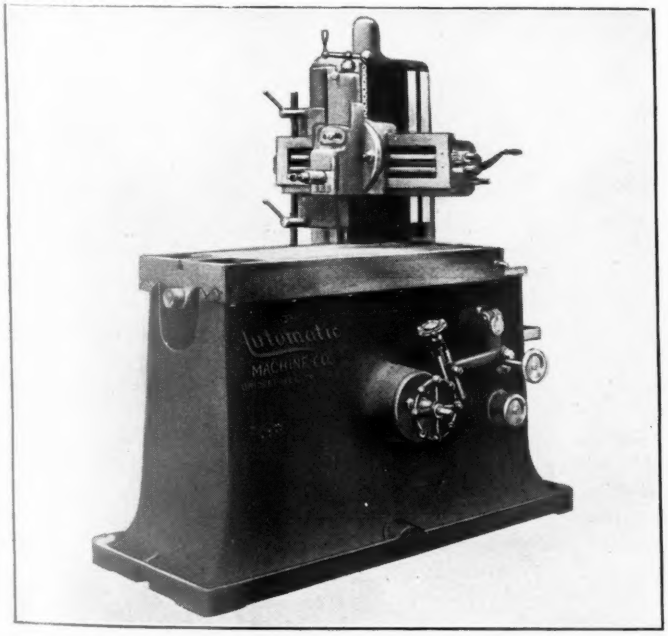
Front Side Rod With Oil Cups Set at an Angle

From the fact that only one-half as many rods as of the standard form of construction need be carried in stock, the saving in costs of material on hand is considerable. The rods can be made up and properly constructed for the same work as the standard rods, no change in counterweights of the engine being necessary.

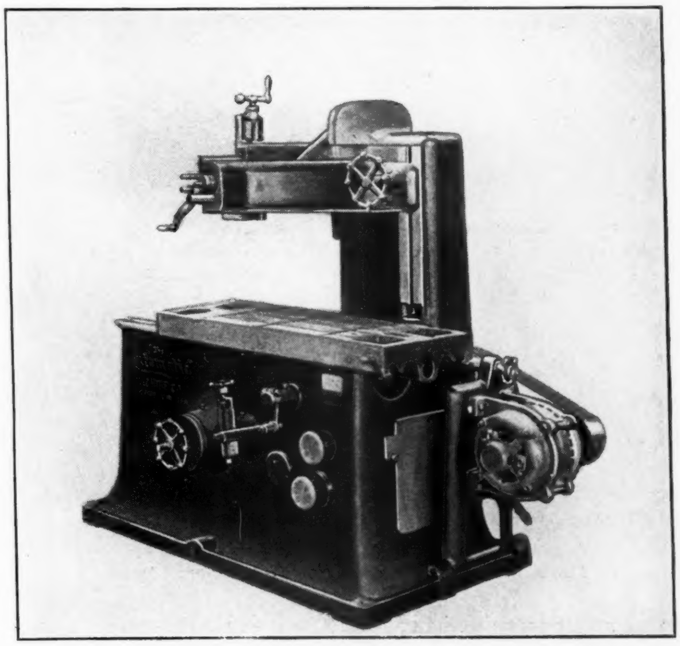
An additional feature carried out in the design of front side rods is shown in the illustration. Usually when the front section of a pair of side rods is to be removed, the engine is set with the crank pin on the bottom quarter and, in this position, the oil cup on the front side rod section extends above the bottom guide and cannot be removed without jacking up the engine. To obviate this difficulty, the side rod illustrated was designed and patented by three employees of the Delaware, Lackawanna & Western at Scranton, Pa., Charles E. Weitaw, William R. Owens and H. R. Jones. As indicated, the oil cups are set at an angle so that the upper corner of the oil cup extends only slightly above the crank pin collar. A considerable saving of effort will be effected by the use of this rod inasmuch as it can be removed easily without jacking up the engine.

Open Side Planer Proves a Flexible Unit

A MACHINE that is equally well adapted to perform small planing operations on irregular shapes either in roundhouses or back shops, has been developed recently by the Automatic Machine Company, Bridgeport, Conn. The machine referred to is the Coulter open side planer, which has already proved its value for this kind of work.



Coulter Openside Crank Planer With 24-In. Stroke



View Showing Motor Drive and Rigid Arm Construction

Railway shop men are waking up to the advantages afforded by open side planer construction, among which is maximum ease in setting up the work, large or small pieces being held with equal facility and ample room being provided for the use of table fixtures. The clear view afforded makes it easy to adjust the cutting tool to lay-out lines on either end of the work, both ends being equally visible. Irregular shapes of a larger size than could pass between two housings are easily machined on the open side machine.

Another advantage of this particular open side planer is the fact that it bridges the gap between planer and shaper construction. The convenience and speed of the shaper is combined with the accuracy and increased capacity of the

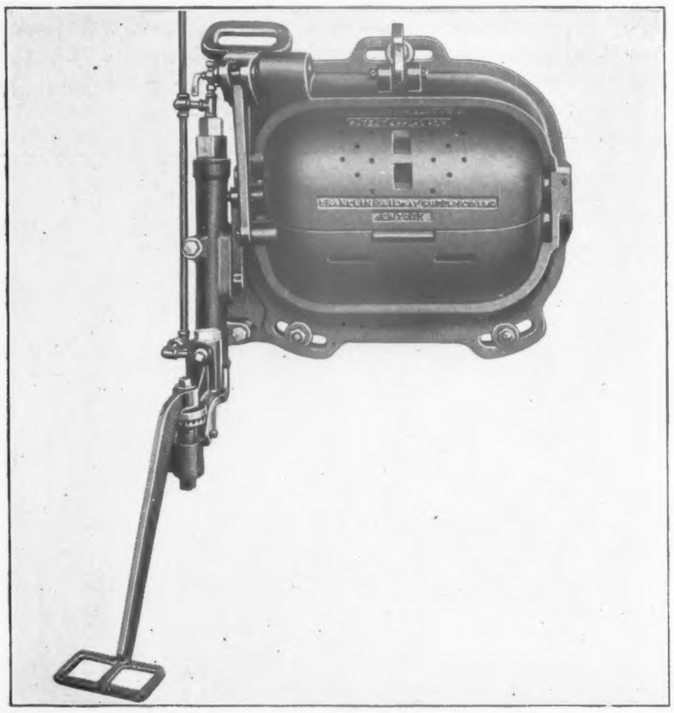
planer. Floor space is saved and ease of operation combined with high cutting speeds and feeds assures maximum output. Horizontal, vertical and angular power feed is provided, with graduated collars on the feed screw and the swivel plate. A rack and pinion raises and lowers the balanced cross rail. Sliding gears allow four speeds for each length of the table stroke.

The large supporting base forms a rigid foundation for the machine and other features tending to provide increased rigidity and accurate work are, the long, wide gibbed table provided with three tee slots and three squaring slots, the large vertical column supporting the cross rail, the length and breadth of the sliding surface on the vertical column and cross rail and the long vertical down feed slide. The bull gear, hub bearing and crank are of rugged construction and the design provides a quick return stroke to the table. Reference to the illustration showing the arrangement for motor drive indicates the compact drive arrangement. A short continuous belt gives excellent results in service, although a silent chain drive can be used if desired.

The open side counterweighted cross rail is securely held in any position by three clamps; two handles on the front are tightened by a half turn and there is a hand wheel on the rear of the arm. The design of the cross rail and braces, all in one piece, reduces the possibility of spring and provides a rugged construction.

An Easily Applied Automatic Fire Door

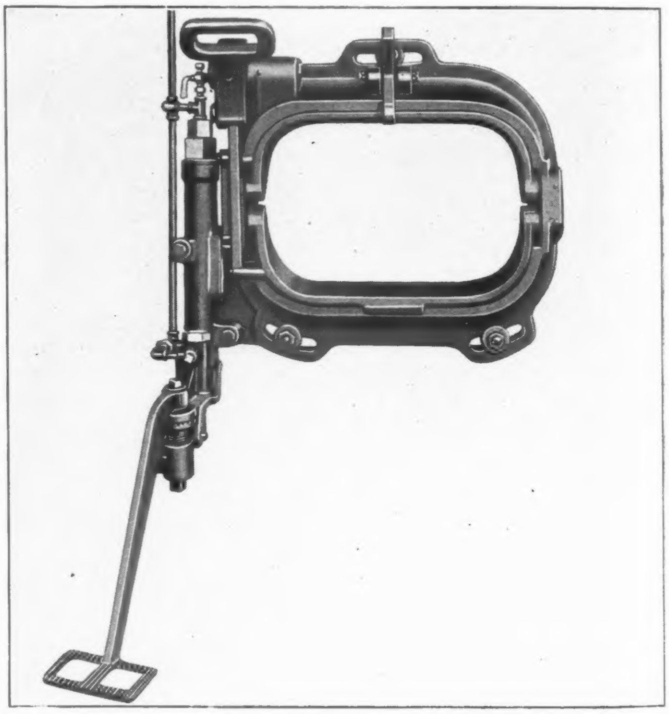
PNEUMATICALLY operated fire doors are sometimes troublesome to apply because of the additional room required for opening. The back head of a modern locomotive has little unused space and to avoid interference with the various devices and their connections, that are necessary for efficient and safe locomotive operation, is often difficult. The Franklin No. 9 fire door was designed to permit of application where space is limited. It takes approximately the same space as an ordinary hand operated swing door and can be applied without relocating other boiler accessories. It is simple in construction and has few wearing parts. It consists of a door frame, semi-rotating door plates and operating cylinder with a foot pedal to provide power operation, and a hand grip for manual operation. A latch is provided to hold the door open in three different positions; wide open and two smoke notch positions. Air pressure both



Franklin No. 9 Automatic Fire Door Closed

opens and closes the door; therefore it is positive in its movements. The movement of the upper door plate is actuated by the power cylinder, the motion being transmitted to the lower door plate by links. In opening, the door plates telescope inside the door frame providing full unobstructed opening for firing. This telescopic action forms the opening without taking space on the backhead outside of the door frame. The door plates rotate on pin bearings on either side.

In operation, pressure on the pedal admits air to the operating cylinder and the piston moves upward, transmitting motion to the upper door to rotate it around its pivots. This door is connected by a link to the rocker at the top of the frame, which in turn is connected by a link to the lower door



Automatic Fire Door in Full Open Position

so that the movement of the upper plate is transmitted to the lower plate to rotate it on pivots to the open position. At the top of the cylinder a small poppet valve is opened by the upward movement of the piston; this admits air to the cylinder and cushions the upward stroke of the piston at the same time the links are assuming a position which reduces the leverage on the doors and brings them to the full open position without slam or shock.

When pressure is removed from the foot pedal, air is exhausted from the lower end of the cylinder and the air in the upper end forces the piston downward and starts the doors toward the closed position. After the piston has traveled about one-third of its movement the valve in the top of the cylinder seats, cutting off the air supply entirely. At this time the top door has traveled to a point where its weight is effective to raise the lower door. This, with the trapped air in the top of the cylinder, brings the doors to the closed position. As the piston travels downward the lower end of the cylinder acts as a dash pot and prevents slamming.

Railway Mechanical Engineer

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WE GUARANTEE, that of this issue 10,100 copies were printed; that of these 10,100 copies, 9,420 were mailed to regular paid subscribers, 9 were provided for counter and news company sales, 256 were mailed to advertisers, 32 were mailed to employees and correspondents, and 383 were provided for new subscriptions, samples, copies lost in the mail and office use; that the total copies printed this year to date were 84,050, an average of 12,007 copies a month.

THE RAILWAY MECHANICAL ENGINEER is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.).

The Times Trade Supplement (London) is authority for the statement that owing to the shortage of raw materials, Belgian manufacturers have been obliged to refuse large orders for railway material, locomotives and wagons needed for South America.

A seat for a brakeman is being provided on freight locomotives in Canada, all engines to be equipped by May 1, 1921. This action has been taken on the recommendation of the Railway Association of Canada, following a request from the brakemen's brotherhood.

The Bureau of Valuation of the Interstate Commerce Commission held an informal meeting with representatives of carriers at Chicago on April 29 and 30. Engineers from roads in all sections of the country were present to discuss the progress made by the bureau in the preparation of valuation reports.

After a spirited debate resolutions were adopted in favor of government ownership of the railroads at the annual convention of the American Federation of Labor at Montreal, Que., on June 17, by a vote of 578 delegates, representing 29,159 votes in favor of the resolution and 8,349 against it. During the debate President Gompers took the floor against the passing of the resolution.

It was stated in the last report of the Indian Railways that 112 locomotives were burning oil fuel. It is anticipated that, owing to the increased output of oil from the Persian concessions of the Anglo-Persian Oil Company, the use of oil fuel on the railways of Western India will in the near future be extended. Tests conducted on this system on 20 engines fitted with different types of burners showed that the work done by one ton of oil would require 1.8 tons of coal.

Four French railroads announce that they will dismiss the men from their large shops and will have car and locomotive repairs done by contract. This is the gist of a cable despatch of May 17. The four roads are the State, the Orleans, the Paris, Lyons & Mediterranean and the Southern. The reason given for this action is that the shops were hotbeds of radicalism and their output was low. Ten thousand men will be released. Repairs will be done by private corporations able to discharge unwilling workers. The railroads are restricted by law in dealing with their employees.

The Order of Railroad Station Agents, at its biennial convention recently held at Pittsburgh, Pa., voted, after discussions lasting three days, to eliminate the word "strike" from its constitution. This action was taken because of the organization's faith in the provisions of the Transportation Act for the handling of employees' grievances. The organization also voted to remove its headquarters from Boston, Mass., to Chicago. So far as can be ascertained at the present time, this is the first organization of the kind, composed of railroad employees, which has, because of this faith, eliminated strike clauses from its constitution.

Pupils of John Marshall high school machine shop classes (Richmond, Va.), under the supervision of their instructors, built a 22-in. modern engine lathe during shop classes in exactly seven months and three days from the time it was started and the machine is now in operation in the school machine shop, where it will become a permanent addition to the present equipment. Every detail of the machine was designed, drawn and constructed by the pupils themselves. It is valued at $1,800, is 7 ft. 6 in. in length and weighs about 2,500 lb. It will swing a piece of work 22¼ in. in diameter and is 46 in. between centers. It has cross and longitudinal feeds, adjustable compound rest, and is capable of cutting screw threads from one to 52 threads per inch. The construction of the machine involved nearly every principle that should be taught in modern machine shop practice, according to the instructors of the class.

Wage Award Announcement Set for July 20

The United States Railroad Labor Board issued a statement on June 25, through its chairman, Judge R. M. Barton, to the effect that a decision on the billion dollar wage demands of organized railway employees, which the board has had under consideration since April 20, will be announced on or possibly before July 20. The public hearings on these demands terminated on June 2 and since that time the Labor Board has been in executive session.

Inspection of Freight Equipment

In the March issue of the *Railway Mechanical Engineer* on page 150, the location of the brake shaft on drop end low side gondolas, drop and high side gondolas, tank cars and caboose cars without platforms, was given as on the end of

the car to the left of the center and not more than 22 in. from the center. This is an error, as the safety appliance act requires the brake staff to be located on the end of the car to the left of the center, but does not specify any limiting dimension.

A. S. M. E. Railroad Section

In accordance with certain changes in the organization of the American Society of Mechanical Engineers, allowing for the formation of professional sections, a Railroad Section has recently been organized. The following officers have been elected: Chairman, Edwin B. Katte, chief engineer electric traction, New York Central; vice-chairman, George W. Rink, assistant superintendent of motive power, Central Railroad of New Jersey; other members of the executive committee, C. W. Huntington, president, Virginian Railway; Harry B. Oatley, Locomotive Superheater Company, and W. H. Winterrowd, chief mechanical engineer, Canadian Pacific Railway. It is understood that the Railroad Section will arrange for a special part in the program at the annual meeting of the society in New York next December.

Cost of Running a Railroad One Day

The second step in the reclamation campaign which has been instituted on the Chicago, Milwaukee & St. Paul, as noted in the *Railway Mechanical Engineer* for April, page 247, has been taken, in the form of a poster showing the daily expenditures on the road for fuel, lumber, etc. According to the poster, which is printed in brilliant red, 36 cents is paid for materials and supplies out of every dollar received by the company. It is also stated that every 24 hours the road spends:

$45,800	for fuel for locomotives.	$1,620	for station supplies.
13,700	for lumber and timber.	1,510	for shop machinery and tools.
10,200	for enginehouse expense.	1,320	for lubricants and supplies for locomotives.
8,660	for train supplies.	300	for electric light bulbs.
8,400	for ties.		
1,750	for stationery and printing.		

The committee asks for the co-operation of the employees to increase efficiency, save material and prevent waste in order to reduce the costs noted in the above items.

Changes in Rules of Interchange

V. R. Hawthorne, secretary, American Railroad Association, Section III, announces that rule 3, section k, of the rules of interchange, 1919, has been modified to read "No car will be accepted in interchange unless properly equipped with United States safety appliances, or United States safety appliances, standard, except cars moving home on car service orders, for equipping with safety appliances. Cars will not be accepted from owner at any time unless equipped with United States safety appliances or United States safety appliances, standard."

Also that rule 3, section o, is modified to read "Cars built after November 1, 1920, will not be accepted in interchange unless equipped with 6-in. by 8-in. shank A.R.A. standard type D couplers."

Working Conditions in the Prussian State Railroad Repair Shops

The Charlottenburger Neue Zeit gives some interesting facts and figures about the working conditions in the repair shops of the former Prussian State Railroad. In consequence of the demobilizing act the number of working men employed by the repair shops was increased from 70,000 to 160,000. Notwithstanding this great increase the shops are unable to meet the demands made upon them. The decrease of efficiency of the repair shops is one of the most serious problems facing the railroad management. The fact that efficiency has gone down although the railroad management spent 447,000,000 marks in 1918, and 110,000,000 marks in 1919, for the improvement of equipment, and although the materials needed, especially copper, have been delivered in the meantime in sufficient quantities, tends to show the serious aspect the situation has taken. In the summer of 1919, the repair shops turned out 750 repaired locomotives monthly. In November, 1919, only 650 were repaired and in January, 1920, only 520 locomotives were repaired.

A. I. E. E. and A. S. M. E. to Combine Forces

Plans have been made for holding a series of joint meetings of the American Institute of Electrical Engineers and the American Society of Mechanical Engineers. The object of the joint meetings is to secure a strong program and, as the war interrupted interest in normal engineering progress, to create a new interest in old problems which now require revised consideration under existing conditions. In general the subjects selected for these meetings will come under the following classifications: Marine engineering, engineering education, industrial installations, power generation, steam railroad electrification and industrial relations. It is intended to hold the first meeting in October, on a date to be announced later.

Railway Rolling Stock for New Zealand Government

The New Zealand Government has announced, writes Consul General Alfred A. Winslow from Auckland on April 10, as noted in Commerce Reports, that the railway department will expend about $8,516,375 for the purchase of rolling stock for government railroads of this Dominion, covering 65 locomotives, 35 passenger cars, 12 brake vans, and 4,092 freight cars.

It is announced that the government proposes to invite tenders in England for the manufacture of 25 large locomotives and 2,500 freight cars; and tenders in New Zealand for the building of 1,000 freight cars to be delivered in the shortest possible time.

In addition to the above the department is providing for the building of 20 locomotives, 35 passenger cars, 12 brake vans, and 592 freight cars in its own shops at the different centers. Twenty locomotives are now being built under contract by A. & G. Price, all to be delivered within five years.

Rolling stock is greatly needed, since the government railroads are not able to meet the increasing amount of freight offered for transportation, and the accumulation of all classes of traffic throughout the Dominion is very great.

It would seem, adds Mr. Winslow, that it would pay American interests to investigate this opening, for it is not probable that British manufacturers will be able to deliver these locomotives and cars in time to relieve the freight situation within a reasonable time, and rolling stock allotted for construction in this dominion cannot be supplied within the next four or five years unless labor conditions change very materially. In any event much of the material to be used in the construction of this rolling stock in New Zealand must come from outside and will call for hardware, car-building accessories, and certain lines of timber.

Interested parties should correspond with the Minister of Railways covering the general contracts, and with A. & G. Price at Thames or Auckland relative to supplies for the 20 locomotives they are building.

MEETINGS AND CONVENTIONS

Traveling Engineers' Association.—The next convention of the Traveling Engineers' Association will be held in Chicago, commencing September 14, 1920.

Master Car and Locomotive Painters' Association.—This association will hold its next convention on September 14 to 16, inclusive, at the New American House, Hanover street, Boston, Mass.

American Railway Tool Foremen's Association.—The next convention of this association will be held at the Hotel Sherman, Chicago, on September 1 to 3, 1920, inclusive.

Master Blacksmiths' Association.—The International Railway Master Blacksmiths' Association will hold its next annual convention at the Hotel Statler, Detroit, Mich., on August 17, 18 and 19. The secretary of the association is A. L. Woodworth, Lima, Ohio. The president of the supply Men's Organization is H. D. Kelley, 1427 Western avenue, N. S., Pittsburgh, Pa.

American Gear Manufacturers' Association.—At a meeting of the executive committee on May 1, held at the close of the convention of this association, the following officers were elected: F. W. Sinram, president; H. E. Eberhardt, vice-president, and Frank D. Hamlin, secretary and treasurer. Messrs. Sinram and Hamlin have served as president and secretary, respectively, since the organization of the American Gear Manufacturers' Association three years ago, during which time it has grown from eight to eighty member companies. One of the chief features of the convention was the discussion of standardization as it affects the gear industry, an entire day being devoted to this subject.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs:

Air-Brake Association.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

American Railroad Association, Section III—Mechanical.—V. R. Hawthorne, 431 South Dearborn St., Chicago.

American Railroad Association, Section VI.—Purchases and Stores.—J. P. Murphy, N. Y. C., Collinwood, Ohio.

American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association.—C. B. Baker, Terminal Railroad, St. Louis, Mo.

American Railway Tool Foremen's Association.—R. D. Fletcher, 1145 E. Marquette Road, Chicago. Convention September 1-3, Hotel Sherman, Chicago.

American Society for Testing Materials.— C. L. Warwick, University of Pennsylvania, Philadelphia, Pa.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York.

American Steel Treaters' Society.—W. H. Eisenman, 154 E. Erie St., Chicago.

Association of Railway Electrical Engineers.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & W. Station, Chicago.

Canadian Railway Club.—W. A. Booth, 131 Charron St., Montreal, Que. Meetings second Tuesday in month, except June, July and August.

Car Foremen's Association of Chicago.—Aaron Kline, 626 North Pine Ave., Chicago. Meetings second Monday in month, except June, July and August, Hotel Morrison, Chicago.

Car Foremen's Association of St. Louis.—Thomas B. Koeneke, secretary, Federal Reserve Bank Building, St. Louis, Mo. Meetings first Tuesday in month at the American Hotel Annex, St. Louis.

Central Railway Club.—H. D. Vought, 95 Liberty St., New York. Meetings second Friday in January, March, May and September and second Thursday in November, Hotel Statler, Buffalo, N. Y.

Chief Interchange Car Inspectors' and Car Foremen's Association.—J. C. Keene, Decatur, Ill.

Cincinnati Railway Club.—H. Boutet, 101 Carew Building, Cincinnati, Ohio. Meetings second Tuesday in February, May, September and November.

International Railroad Master Blacksmiths' Association.—A. L. Woodworth, B. & O., Lima, O. Convention August 17-19, Hotel Statler, Detroit, Mich.

International Railway Fuel Association.—J. G. Crawford, 702 East 51st St., Chicago.

International Railway General Foremen's Association.—William Hall, 1061 W. Wabasha Ave., Winona, Minn. Convention Sept. 7-10, 1920, Hotel Sherman, Chicago.

Master Boilermakers' Association.—Harry D. Vought, 95 Liberty St., New York.

Master Car and Locomotive Painters' Association of U. S. and Canada.—A. P. Dane, B. & M., Reading, Mass. Convention September 14-16, New American House, Boston, Mass.

New England Railroad Club.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Meetings second Tuesday in month, except June, July, August and September.

New York Railroad Club.—H. D. Vought, 95 Liberty St., New York. Meetings third Friday in month, except June, July and August, 29 W. 39th St., New York.

Niagara Frontier Car Mens' Association.—George A. J. Hochgrebe, 623 Brisbane Building, Buffalo, N. Y. Meetings third Wednesday in month, Statler Hotel, Buffalo, N. Y.

Pacific Railway Club.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Meetings second Thursday in month, alternately in San Francisco and Oakland.

Railway Club of Pittsburgh.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Meetings fourth Friday in month, except June, July and August, American Club House, Pittsburgh.

St. Louis Railway Club.—J. B. Frauenthal, Union Station, St. Louis, Mo. Meetings second Friday in month, except June, July and August.

Traveling Engineers' Association.—W. O. Thompson, N. Y. C. R. R., Buffalo, N. Y. Convention September 14, Chicago.

Western Railway Club.—J. M. Byrne, 916 West 78th St., Chicago. Meetings third Monday in month, except June, July and August.

PERSONAL MENTION

GENERAL

G. L. Lambeth, superintendent of motive power and car equipment, of the Mobile & Ohio, has moved his headquarters from Mobile, Ala., to St. Louis, Mo.

G. C. Nichols, superintendent of motor power and equipment of the Alabama, Tennessee & Northern, with headquarters at York, Ala., has been promoted to superintendent, with the same headquarters, and his authority has been extended over the maintenance of way and transportation departments.

John C. Davidson has been appointed engineer of electric traction of the Norfolk & Western, with office at Bluefield, W. Va. Mr. Davidson's early experience in railroad work was obtained in Scotland where he completed his apprenticeship in the locomotive department of the Great North of Scotland Railway. After completing his apprenticeship he was employed in the drafting room and on material inspection and testing. From 1902 to 1906 he was employed by the British Westinghouse Company as assistant engineer on design of rolling stock and electrical equipment for the Mersey Railway and the Metropolitan Railway electrifications. Mr. Davidson then took up work in the United States and was employed for four years as assistant engineer by the Pennsylvania Tunnel & Terminal Railroad. In this connection he worked on the electrification of the New York tunnels, specializing in the development of locomotive equipment. He entered the employ of Gibbs & Hill, consulting engineers when the firm was organized. Here he was employed as engineer on projects and designs, appraisals and reports for heavy main line electrification and was engineer in charge of the Norfolk & Western electrification. He resigned from this work to accept his present position.

J. C. Davidson

G. G. Yeomans, general purchasing agent of the New York, New Haven & Hartford, with headquarters at New Haven, Conn., has been appointed special assistant to the president, handling all matters assigned relating to materials and supplies.

C. B. Young, manager of the Test Section of the United States Railroad Administration, has been reappointed mechanical engineer on the Chicago, Burlington & Quincy, with headquarters at Chicago.

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

Edward G. Bowie, who has been appointed division master mechanic of the Brownville division of the Canadian Pacific, with headquarters at Brownville, Me., as announced in last month's issue, was born on August 20, 1892, at Winnipeg, Man. He was educated in Aberdeen High School

and began railroad work in May, 1907, as a machinist apprentice, after which he worked as a machinist until July, 1915. He was then a dynamometer car operator on the Eastern lines until October, 1915, assistant locomotive foreman and locomotive foreman until June, 1918, being located respectively at Outremont, Que., Sherbrooke, Que., and Smith's Falls, Ont. From June, 1918, to April, 1920, he was general foreman in charge of the Canadian Pacific shops at McAdam, N. B., and on the latter date received his appointment as division master mechanic at Brownville, Me.

James Davis has been appointed road foreman of engines on the Southern Pacific, with headquarters at Sparks, Nev., succeeding S. A. Canady, who has been assigned to other duties.

Charles W. McGuirk, assistant master mechanic of the Delaware, Lackawanna & Western at Scranton, Pa., has been appointed master mechanic of the Delaware & Hudson at Carbondale, Pa., effective July 1. Mr. McGuirk was born in Norfolk, Conn., on June 3, 1872, and was educated in St. John's School, Schenectady, N. Y. He served a four-year machinist apprenticeship at the Oneonta shops of the Delaware & Hudson. Subsequently he was employed as enginehouse and shop foreman on the New York, Ontario & Western, the Lehigh Valley and the Boston & Maine. In 1906 he accepted a position as foreman of the new enginehouse of the Delaware & Hudson at Oneonta, N. Y., and was promoted to general foreman of the locomotive and car departments in 1908, remaining with the latter road until April, 1912. At that time he went to the Delaware, Lackawanna & Western as general roundhouse foreman at Scranton, Pa., and about four years ago was promoted to the position of assistant master mechanic.

H. W. Sasser has been appointed superintendent of shops of the Erie at Galion, Ohio, succeeding A. J. Davis, transferred.

CAR DEPARTMENT

J. A. Deppe, assistant master car builder of the Chicago, Milwaukee & St. Paul, with headquarters at Milwaukee, Wis., has been appointed supervisor of the freight car department, with the same headquarters, succeeding C. G. Juneau.

C. G. Juneau has been appointed acting master car builder of the Chicago, Milwaukee & St. Paul, with headquarters at Milwaukee, Wis., succeeding L. K. Sillcox. Mr. Juneau was born on December 12, 1874, at Milwaukee and received a public school education. He served a blacksmith apprenticeship in the car and locomotive departments of the Chicago, Milwaukee & St. Paul, which he completed on October 1, 1899, after which he was employed for about a year as a tool dresser by the Strobel Structure Company, Chicago, returning to the Chicago, Milwaukee & St. Paul on July 21, 1900, working in the car department. On February 12, 1906, he was appointed assistant foreman of the blacksmith shop. On March 1, 1918, he was appointed general foreman of the car blacksmith department for the entire system and on June 1, 1918, was made general supervisor of the freight car department, including the blacksmith department. In March, 1920, he was placed in charge of the Milwaukee terminal and shop district and on June 1, 1920, received his recent appointment.

Henry Marsh, formerly passenger car foreman of the Chicago & North Western, with headquarters at Chicago, has been appointed district master car builder of the same road, with office at Winona, Minn.

A. S. Sternberg, general foreman of the Belt Railroad of Chicago, with headquarters at Chicago, Ill., has been made master car builder, the position of general foreman being abolished.

C. L. Walker has been appointed master car repairer at the Los Angeles, Cal., general shops of the Southern Pacific.

SHOP AND ENGINEHOUSE

Harry G. Becker, who was recently appointed shop superintendent of the Delaware & Hudson at Colonie, N. Y., as announced in the June issue, has been engaged in railroad work since 1901, at which time he entered the employ of the Chicago, Burlington & Quincy at Beardstown, Ill., as a machinist apprentice. He remained with that road as a machinist and draftsman until 1909, when he accepted a position as shop demonstrator at the Sayre shops of the Lehigh Valley. He was later machine foreman and general erecting foreman until 1915, when he left the service of that road to accept the position of general foreman of the Delaware & Hudson at Colonie, New York, which he held until his recent promotion to the position of shop superintendent.

PURCHASING AND STOREKEEPING

L. J. Ahlering, traveling storekeeper on the Chicago & Eastern Illinois, with headquarters at Danville, Ill., has been promoted to general storekeeper, with the same headquarters, succeeding W. T. Bissell, who has resigned.

R. B. Bannerman has been appointed storekeeper on the Chicago division of the Minneapolis, St. Paul & Sault Ste. Marie, with headquarters at Fond du Lac, Wis.

H. S. Burr, superintendent of stores of the Erie Railroad at Meadville, Pa., has been appointed general superintendent of stores, with headquarters in New York.

E. A. Ernst, chief clerk in the office of the district storekeeper of the Chicago, Rock Island & Pacific at Horton, Kan., has been promoted to district storekeeper at Shawnee, Okla., succeeding E. W. Morris, deceased.

W. L. Hunker, district storekeeper of the Chicago, Rock Island & Pacific, at Chicago, has been transferred to Silvis, Ill., succeeding J. C. Kirk.

J. C. Kirk, district storekeeper on the Chicago, Rock Island & Pacific, with headquarters at Silvis, Ill., has been promoted to assistant general storekeeper, with the same headquarters.

J. B. Noyes has been appointed storekeeper on the Soo division of the Minneapolis, St. Paul & Sault Ste. Marie, with headquarters at Minneapolis, Minn.

N. M. Rice, vice-president of the Pierce Oil Corporation, St. Louis, Mo., has been appointed general purchasing agent of the New York, New Haven & Hartford, succeeding G. G. Yeomans.

J. H. Sweeney, storekeeper for the Erie at Meadville, Pa., has been appointed superintendent of stores at Meadville, succeeding H. S. Burr.

E. L. Zink, chief clerk in the office of the district storekeeper of the Chicago, Rock Island & Pacific at Silvis, Ill., has been promoted to district storekeeper, at Chicago.

OBITUARY

George H. Hazelton, formerly division superintendent of motive power of the New York Central & Hudson River at Albany, died on June 10. Mr. Hazelton was in the service of the New York Central, or associated lines, for more than 53 years, starting on the Rome, Watertown & Ogdensburg. He was superintendent of motive power of that road when it was taken over by the New York Central, and was made division superintendent of motive power at Albany.

During recent years he has been assigned to special duties, retiring last fall, when he was 70 years of age. After his retirement, however, he was called back into the service for special work.

Colonel W. D. Mann, designer of the "boudoir sleeping car," used extensively in Europe, and formerly for a number of years in this country (on the Cincinnati, New Orleans & Texas Pacific), died at his home in Morristown, N. J., on May 17, at the age of 81 years.

Wilson Worsdell, formerly chief mechanical engineer of the North Eastern Railway of England, died recently at South Ascot, Berkshire, England, his death being reported in the Railway Gazette (London) of April 16. Mr. Worsdell was a pupil at the Altoona shops of the Pennsylvania Railroad when he was a young man and began his railway service in England on the London & North Western. He was at the head of the mechanical department of the North Eastern from 1890 to 1910. During this period he built about 1,000 locomotives and several thousand cars. He introduced high capacity freight cars. He had been president of the Association of Railway Locomotive Engineers, and for several years past had been a director of the Westinghouse Brake Company.

Frederick O. Robinson, for many years chief clerk to the superintendent of motive power of the Chesapeake & Ohio, and secretary of the Richmond Railroad Club, died on March 26, 1920, at a hospital in Richmond, Va. He had been in failing health for several years. Mr. Robinson was born in Farmington, N. H., on August 20, 1852, and began his railroad career with the Indianapolis & St. Louis in 1872, serving as telegraph operator for two years. He was later employed by the Indianapolis, Peru & Chicago for 16 years as chief clerk to the master mechanic. He served in the capacity of telegraph operator and clerk for the Wabash and as chief clerk to the general superintendent of the Lake Erie & Western. In 1892 he entered the service of the Chesapeake & Ohio as clerk to the purchasing agent, being later promoted to chief clerk of that department, in which capacity he served until 1895 when he was appointed chief motive power clerk, holding this position for 16 years under the late W. S. Morris and James F. Walsh. In 1911 he was appointed equipment clerk of the Chesapeake & Ohio, which position he filled until recently. On the organization of the Richmond Railroad Club Mr. Robinson was elected secretary-treasurer and held that office until his death.

F. O. Robinson

High wages and lessened efficiency still support high prices. There are as many workingmen in the country today as there were a year ago, or two years ago. But their output is not so great and their wages much higher. Production costs are therefore increased. Strikes, holidays, vacations and diminished output per man all add to the price of goods, and hold up the price level. Labor inefficiency and sabotage are to be found in the transportation question, affecting distribution and hindering an orderly recession of prices.—*The Wall Street Journal.*

SUPPLY TRADE NOTES

G. E. Lemmerich, railroad layout engineer for the Austin Company, Cleveland, Ohio, died on April 25, of heart failure.

A. B. Konsberg, dealer in railway equipment, has moved his offices from 226 South La Salle street, Chicago, to 40 North Dearborn street.

John Scullin, chairman of the board of the Scullin Steel Company, St. Louis, Mo., died in St. Luke's Hospital, St. Louis, on May 28, at the age of 83.

W. G. Cook, manager of the Chicago office of the Garlock Packing Company, Palmyra, N. Y., has been transferred and is now manager of its Philadelphia, Pa., office.

W. Searle Rose, district manager of W. L. Brubaker & Brothers, manufacturers of taps, dies and reamers, 50 Church street, New York, has been appointed sales manager.

F. J. Foley, general sales agent, and E. McCormick, assistant to the president of the Railway Steel Spring Company, have been elected vice-presidents of the company.

The Cleveland office of the Electric Storage Battery Company, Philadelphia, Pa., has been moved from the Citizens building to Chester avenue and East Twenty-fourth street.

The Buda Company, Harvey, Ill., recently completed the construction of an additional foundry, for casting small engine parts. The building is of iron, 160 ft. wide, with concrete foundation.

The Rich Tool Company, Chicago, announces that the Garlock-Walker Machinery Company, Ltd., with offices in Toronto, Montreal and Winnipeg, has been appointed its exclusive agent for Canada.

W. F. Myer has been appointed directing transmission engineer, industrial bearings division, of the Hyatt Roller Bearing Company, New York. Mr. Myer is in charge of the sale of Hyatt line shaft roller bearings.

The R. W. Young Manufacturing Company, electric turntable tractors, electric hoists and cranes, announces its removal from 80 East Jackson boulevard, to the Harris Trust building, 111 West Monroe street, Chicago.

A. C. Johnston, chief engineer of the Link Belt Company, Chicago, has been promoted to vice-president and resident general manager of the Chicago plant, succeeding Prentiss L. Coonley, who is devoting his time to other duties.

Ernest S. Jubell, in charge of materials at the plant of the Haskell & Barker Car Company, Michigan City, Ind., has been appointed general superintendent of the Union Railway Equipment Company, with headquarters at Hammond, Ind.

The George P. Ladd Company, Pittsburgh, Pa., manufacturer of water tube boilers, has opened a district sales office at 528 McCormick building, Chicago, in charge of W. M. McKinstrey, formerly district manager for the Page Boiler Company, Chicago.

The Union Railway Equipment Company, Chicago, has purchased a tract of land at Hammond, Ind., and is now erecting shops for the manufacture of its railroad freight car specialties. When completed the plant will total an investment of approximately $1,500,000.

George F. Smardon, who served as secretary and assistant to Carl R. Gray, director of operation, United States

Railroad Administration, during federal control, has become associated with the Anchor Packing Company, Philadelphia, as railway representative for eastern railroads.

B. G. Prytz has resigned as president of the SKF Industries, Inc., having been elected managing director of the parent company, with headquarters at Gothenburg, Sweden. F. B. Kirkbride, vice-president since the organization of the company, was elected president to succeed Mr. Prytz.

The Electric Controller & Manufacturing Company, Cleveland, Ohio, has opened a branch office in Boston, Mass., at 49 Federal street. The new office is in charge of M. D. Goodman. An office has also been opened in St. Louis, Mo., at 208 North Broadway, in charge of R. J. Ehrhart.

The Rome Iron Mills, Inc., New York, manufacturer of solid and hollow locomotive staybolt and engine bolt iron, announces the appointment of A. M. Castle & Company as its western representative. The latter company has offices in the principal western cities, with warehouses at Chicago and Seattle.

The Chicago Flexible Shaft Company, Chicago, has opened an office in the Railway Exchange building, St. Louis, Mo., in order to render more efficient service and distribution in the southwest territory. The office is in charge of Otto Bersch, formerly connected with the Brown Instrument Company, and Jack Stroman.

DeWitt V. D. Reiley, vice-president of the Davis-Bournonville Company, Jersey City, N. J., has been elected president, succeeding Augustine Davis, who resigned last November. Charles B. Wortham, treasurer of the company since its organization, was elected vice-president and William G. McCune secretary and treasurer.

Whitfield P. Pressinger, first vice-president and general manager of the Chicago Pneumatic Tool Company, with headquarters in New York, died recently at the Roosevelt Hospital in New York following an operation. Mr. Pressinger was born at New York on September 27, 1871. He received a public school education and shortly after beginning work he entered the employ of the company in whose service he rose to the rank he occupied at the time of his death. Mr. Pressinger was the author of "Advances of Compressed Air," which has been translated into several languages. Besides being a member of many other clubs, he was a member of the New York Railroad Club and the American Society of Civil Engineers. He also served for nine years with Company A, Seventh Regiment.

W. P. Pressinger

J. H. Kuhns, manager of the railroad department of the Republic Rubber Company, has been elected vice-president of the Union Asbestos & Rubber Company, Chicago, which company has been appointed the western railroad sales agent for the Republic Rubber Company. His headquarters will be at 231 South Wells street, Chicago.

The Page Steel & Wire Company has removed its New York offices from 30 Church street, to the offices of the American Chain Company, with which it has been consolidated, in the Grand Central Terminal, New York. The Chicago office of the company has been moved from 29 South La Salle street to 208 South La Salle street.

William Oesterlein, president of the Oesterlein Machine Company, Cincinnati, Ohio, died at his home on May 10. Shortly after coming to Cincinnati about 50 years ago he started a machine tool shop in a small way and is reputed to have built the first milling machine in Cincinnati. He was one of the founders of the machine tool industry in that city.

Allan E. Goodhue, who was managing director of the Chicago Pneumatic Tool Company's English subsidiary, the Consolidated Pneumatic Tool Company, London, England, since May 1, 1919, also director of European sales for the Chicago Pneumatic Tool Company, New York, has been elected vice-president in charge of sales of the latter company, with headquarters at New York. Mr. Goodhue was formerly for a number of years connected with the sales department of the Midvale Steel Company and the Midvale Steel & Ordnance Company in Philadelphia, Chicago and Boston, and left that company in March, 1918, to enter the service of the United States government. He was assistant manager of the steel and raw material section, Production Division of the Emergency Fleet Corporation, until January, 1919, when he became connected with the Chicago Pneumatic Tool Company.

A. E. Goodhue

The Superior Screw & Bolt Company has opened new offices at 810 Hippodrome building, Cleveland. The company, which was recently incorporated, with a capital of $500,000, intends to manufacture a complete line of tap screws and bolts. Officers of the new corporation are: president, M. T. Jones; vice-president, M. J. Riley; secretary and treasurer, W. J. Hayes.

The Norton Company, Worcester, Mass., has opened a branch office for the grinding machine division at 324 Bulletin building, under the direction of Paul Hoffman, district manager. The establishment of this branch office will in no way affect the distribution of Norton grinding wheels; these will be handled as in the past by Powell, Clouds & Co., 602 Arch street, Philadelphia.

K-G Welding & Cutting Company, 556 West Thirty-fourth street, New York, manufacturers of welding and cutting apparatus, has opened a sales office in order to accommodate its western trade, at 12-14 East Harrison street, Chicago, where a complete line of welding and cutting apparatus will be carried. William McCarthy, who has been in charge of the railroad service department, has been appointed western sales manager.

The Greenfield Tap & Die Corporation, Greenfield, Mass., has acquired all of the common stock of the Lincoln Twist Drill Company, Taunton, Mass. This company manufactures twist drills, reamers and milling cutters. These, added to the products of the Greenfield Tap & Die Corporation, give it a complete line of small tools. Edward Blake, Jr., formerly sales manager of Wells Brothers Company, is vice-president and general manager of the Lincoln Twist Drill Company.

Due to the retirement of A. F. Stillman from active interest in the management of The Watson-Stillman Company, New York, several changes in the personnel have been made. E. A. Stillman remains as president and also has full supervision of the sales. Carl Wigtel, chief engineer, has been elected vice-president, J. D. Brocks, treasurer, and A. Parker Nevin, secretary; LeRoy T. Brown has been appointed works manager, J. W. Delano, assistant works manager, and W. H. Martin, purchasing agent.

Charles Blizard, third vice-president of the Electric Storage Battery Company, died on June 12. He was born at Stevens Point, Wis., in 1864, and was educated in the east, graduating from the Brooklyn Polytechnic Institute. In October, 1893, he became associated with the Electric Storage Battery Company and was in the service of the company a total of 27 years. He was at first manager of the New York office and in 1900 he was moved to the home office in Philadelphia in charge of sales. In April, 1906, he was made third vice-president, which position he retained until the time of his death. Mr. Blizard was an active member of the Electric Vehicle Association, serving on various committees, and he later continued his activities in the electric vehicle section of the National Electric Light Association. He was also a member of the board of governors and chairman of the finance committee of the Associated Manufacturers of Electrical Supplies.

C. Blizard

The Reed-Prentice Company, Becker Milling Machine Company and Whitcomb-Blaisdell Machine Tool Company have opened a sales office at the Grand Central Palace for handling sales in the New York territory. The office will be in charge of P. K. Dayton, formerly connected with the Niles-Bement-Pond Company and Manning, Maxwell & Moore, assisted by P. A. Dyer, formerly of the General Electric Company. A store has also been opened in Cleveland at 408 Frankfort avenue, in charge of C. A. Severin, formerly of the Cleveland Tool & Supply Company, assisted by Charles Brandhill.

Frank A. DeWolff, assistant locomotive superintendent of the Cuban Central, has joined the forces of the International Railway Supply Company, 30 Church street, New York, as its traveling representative. Mr. DeWolff was engaged in active railroad work for the past 22 years, having begun as a machinist apprentice in Mexico. He subsequently served as machinist, power house engineer, locomotive fireman, engineman and superintendent of shops. From July, 1916, to January, 1919, he was general master mechanic on the Cuban Central and from the latter date was assistant locomotive superintendent in charge of the locomotive and car departments of the same road.

The personnel of the Elvin Mechanical Stoker Company, New York, is now as follows: John B. Given, president, Albert G. Elvin, vice-president in charge of operation and treasurer; F. H. Elvin, assistant to vice-president in charge of operation; Frank H. Clark, vice-president; Frederick P. Whitaker, secretary; A. B. Fahnestock, chief engineer; H. D. Eckerson, manager of road service. The headquarters of the company are at 23 West 43rd street, New York. The Elvin stoker has been in operation on the Erie for three years and is now being tested out on the Grand Trunk. A description of this stoker and its use on the Erie was published in the *Railway Mechanical Engineer* for February, 1918, page 103.

Percy M. Brotherhood, senior vice-president of Manning, Maxwell & Moore, Inc., New York, has been appointed executive vice-president with the powers and duties attaching to the office of president, succeeding Alfred J. Babcock, president, who resigned on account of ill health. Mr. Brotherhood has been associated with the company for over 25 years and during recent years has been in charge of its machine tool business. Eugene Maxwell Moore was recently elected vice-president in charge of foreign sales. Henry D. Carlton has been elected a director of the corporation, following his recent election to the office of vice-president in charge of the brass goods sales, succeeding the late John N. Derby. Robert A. Bole, general sales manager of Pittsburgh, has also been elected a director and vice-president.

Edward M. Dart, founder of the E. M. Dart Manufacturing Company, Providence, R. I., died June 5, while at his summer home at Shawomet Beach, R. I. He was born January 19, 1835, in New London, Conn., where he received his schooling, and, after gaining mechanical experience in companies in that city, he entered the employ of Law & Kannon, Providence, R. I., manufacturers of gas piping and fixtures. In 1858 he became connected with the Providence Steam & Gas Pipe Company and later went to the Mason Machine Works, Taunton, Mass. He subsequently worked for the firm of Hudson & Wood and the Perkins Horse Shoe Company, both of Providence. In 1866 he established his own business of manufacturing pipe and fittings, which grew until in 1894 he formed the E. M. Dart Manufacturing Company.

L. Finegan, superintendent of the Mt. Clare shops of the Baltimore & Ohio, has been appointed general manager of the American Flexible Bolt Company, with headquarters at Pittsburgh and Zelienople, Pa. Mr. Finegan was born in California. He began work as a machinist apprentice in Butte, Mont. On the completion of his apprenticeship he entered the employ of the New York Central at Buffalo, and later the General Electric Company and the American Locomotive Company at Schenectady. Leaving the American Locomotive Company he went with the Delaware & Hudson as general foreman. In 1904 he became general foreman of the West Springfield shops of the Boston & Albany Railroad. In 1911 he entered the service of the Baltimore & Ohio as master mechanic at Glenwood, Pa., and was later appointed superintendent of shops at this point. In 1915 he was appointed superintendent of the Mount Clare shops.

George H. Scott, electrical engineer with the O. K. Giant Battery Company, with headquarters at Gary, Ind., has been appointed representative of the Safety Car Heating & Lighting Company, New York, in charge of the Northwestern territory, with headquarters at Chicago. Mr. Scott was born on June 6, 1880, in Pulaski county, Mo., and was educated in the State Normal School. He entered the service of the St. Louis-San Francisco at Springfield, Mo., on February 23, 1899, working in various departments of this road until 1906, when he was appointed foreman electrician with headquarters at St. Louis, Mo. In December, 1907, he was appointed traveling electrician on the Chicago, Rock Island & Pacific, with headquarters at Chicago, and was later promoted to general foreman in the electrical department. He was appointed foreman electrician with the Pullman Company at Cincinnati, Ohio, on June 1, 1910, with which company he was employed until his resignation to become electrical engineer with the O. K. Giant Battery Company.

TRADE PUBLICATIONS

Belt Fasteners.—The Crescent Belt Fastener Company, New York, has published a new handbook illustrating Crescent belt fasteners in use on many different kinds of belting and under different conditions, and giving full data regarding their use.

Expansion Joints.—The Griscom-Russell Company New York, has published bulletin No. 1010, an eight-page pamphlet containing specifications for the two types of G-R expansion joints for use on low pressure steam lines to provide for expansion and contraction of the pipe.

Bearing Alloy.—The Ajax Metal Company, Philadelphia, Pa., is distributing a small leaflet describing the composition of Ajax bull bearing alloy and its advantages as a general purpose lining metal. It is claimed to be not only cheaper than genuine and other tin-base babbitts, but to last longer and run cooler.

Car Jacks.—Bulletin No. 301, an eight-page pamphlet, is being distributed by the Duff Manufacturing Company, Pittsburgh, Pa., and gives complete information regarding Duff high speed ball bearing jacks of 50 and 35 tons capacity, designed especially for raising heavy freight and passenger cars in railway repair shops.

Heating Systems.—The Gold Car Heating & Lighting Company's modern heating and ventilating systems for railway cars are described fully in a 40-page catalogue supplement recently issued. The results of laboratory and service tests made during the past winter of the company's latest type vapor valves are also contained in the supplement.

Water Distilling Apparatus.—The Barnstead Still & Sterilizer Company, Chicago, has issued a 20-page pamphlet describing and illustrating its line of water purifiers and stills. This includes several types, for commercial use, laboratory and druggist use, as well as for garages and home drinking water supply. The stills are operated by gas, high pressure steam or electricity, as sources of heat.

Arch Tube Cleaners.—A revised catalogue of locomotive arch tube cleaners (W-4) has been issued by the Lagonda Manufacturing Company, Springfield, Ohio. The catalogue goes into the subject of arch tube cleaning and describes the different types of standard cleaners made by this company, giving a description of their general construction and usage. It also illustrates repair parts and covers briefly several other products.

Superheated Steam in Yard Engines.—Bulletin No. 10, published by the Locomotive Superheater Company, New York, presents data obtained in tests made of two engines in switching service, one using superheated steam and the other saturated. Three classes of switching work were included in the test. An indicator was used and careful readings were taken, the results showing decidedly superior performance for the superheated locomotive over that using saturated steam. Detailed information of the tests is given in the pamphlet and a comparison of the performance of both locomotives is given in tabular form.

Gasoline Locomotives.—Record No. 95, published by the Baldwin Locomotive Works, Philadelphia, Pa., deals with internal combustion locomotives, weighing from 5 to 25 tons, and adapted to work in contracting operations, plantations, quarries, switching in railroad yards, etc. Various changes and improvements have been made in these locomotives since their introduction and the general principles of construction are described and illustrated. A table shows the performance, rating and principal dimensions of the standard sizes of Baldwin gasoline locomotives.

Boiler Makers' Tools.—A new and attractive book which will interest boiler makers has just been published by J. Faessler Mfg. Company, Moberly, Mo. Its 68 pages include a recently developed line of roller expanding and flaring tools for locomotive superheater tubes, locomotive arch tubes, and stationary water tube and marine boiler tubes. Special types of expanders are included for Stirling, B. & W., and Heine boilers. These and other Faessler tools are fully described in detail and illustrated.

Machine Guard Handbook.—A handbook dealing with the subject of machine guards has been compiled for the Consolidated Expanded Metal Companies, Braddock, Pa., and is being issued by that company. It is designed for the use of managers, purchasing agents and guard makers, and contains information regarding the requirements of practical guards, how to obtain suitable guards for any purpose, specifications for letting contracts, what to guard, etc. The booklet contains 44 pages, 4 in. by 7 in., and is illustrated.

Machine Tools.—Under the title of Gisholt products the Gisholt Machine Company, Madison, Wisconsin, has issued a 24-page booklet in which are illustrated the machine tools manufactured by this company. The illustrations include turret lathes, both hand and automatically operated, vertical boring and turning mills, universal tool grinders and horizontal boring and drilling machines. Several of the illustrations show machines set up for performing specific operations. The tools for use on the turret lathes are also illustrated in detail.

Turret Lathe Practice.—A reference book on vertical turret lathe practice in railroad shops has been issued by the Bullard Machine Tool Company, Bridgeport, Conn. The book contains 43 pages, 9 in. by 11 in., and is well illustrated. Detailed illustrations and descriptions of methods of tooling pistons, packing rings, air pump cylinders and rings, cylinder heads, cross heads, rod brasses, driving boxes, eccentrics and straps, throttle boxes, crank pin washers, engine truck centers, etc., are given. The book is extremely valuable as a reference for quick, efficient methods of setting up these locomotive parts and performing necessary machine operations.

Pressed Steel Cars.—A well arranged and beautifully bound catalog has been issued by the Pressed Steel Car Company, New York. It is comprehensive and well written, containing 290 pages, 9½ in. by 11 in. Clear cut illustrations of the company's products are shown on a scale large enough to indicate details. The first two-page spread shows the company's offices and works both in Pennsylvania and Illinois, and other interesting illustrations show the welfare and educational work carried on for the employees. Beginning on page 14, the various pressed steel cars including box, caboose, coke, flat, gondola, tank cars, etc., are illustrated in detail with general dimensions of the cars and a brief description of their construction. The latter part of the catalog shows the method of handling foreign shipments and includes an interesting picture of a group of 3,000 car operators working under the direction of the Pressed Steel Car Company's erecting engineers in Vladivostok, Siberia. Descriptions and illustrations of the company's specialties such as truck and body bolsters, pressed steel and arch bar trucks, brake beams, carlines, steel storage and agitator tanks, etc., are given. The method of manufacturing chilled iron car wheels is explained and tables of decimal equivalents and conversion tables are shown in the back of the catalog.